



**Daviess-Martin Joint County Parks & Recreation Department**

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## **West Boggs Lake**

# **LARE Shoreline Project Design Summary** FINAL DRAFT 2001

**FOR FURTHER INFORMATION, CONTACT::**

**MICHAEL L. AXSOM, SUPERINTENDENT  
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## STATEMENT OF PURPOSE

The purpose of this project is to stabilize portions of the shore of West Boggs Lake. A study of this lake in 1991, mapped and identified extensive areas of shoreline erosion as a major concern for water quality. Since that time, many steps have been taken to stabilize various segments of the lake shore. Typical Rip-Rap projects have been completed along several thousand feet of shore area, and other works, i.e., bio-engineering, have been applied to other segments. The two segments of lakeshore to be included in this project were selected because of the shared qualities of difficulty in access, high visibility, and degree of erosion.

## GENERAL PROJECT DESCRIPTION

*See site location map appendix C*

This project will vary from common practice in the fact that the local project sponsor, the Daviess-Martin Joint County Parks and Recreation Department, will also serve as the general contractor/project manager, using sub-contractors for any necessary materials, labor, equipment and engineering services.

The location of the project is in Section 2, Township 3 N, Range 5 West. Site 1 is in the NW 1/4 of the SW 1/4. Site 2 is in the SE 1/4 of the NE 1/4.

More precise location may be obtained by GPS coordinates.

Site 1 starts at or near coordinates N38° 43' 12.11 " W8~ 56' 24.23", and ends or near N38° 43' 22.58" W86° 56' 17.49".

Site 2 starts at or near coordinates N38° 43' 29.55" W8~ 55' 40.74", and ends at or near N38° 43' 34.57" W86° 55' 37.29".

Several special considerations are involved in the design of this project. Those considerations guide the design to a very narrow set of parameters. Factors taken into consideration include the condition of the lake's fishery and associated habitat.

West Boggs Lake was the site of an extensive, and very successful, fisheries renovation project in 1994. It is not seen as desirable to expose the fishery to a lake level reduction at this time, or at any time in the near future.

The lake is also known to contain a deficit of macrophyte populations. This fact also creates a need to avoid a lake level reduction, if such can be avoided.

The third factor guiding the design away from more typical designs, is the accessibility of the construction sites themselves. Both sites are very difficult to access overland, requiring the crossing of private property. Site One has the added problems of the only overland route ending at the top of a 30 foot nearly vertical slope. Reshaping this slope for a typical Rip-Rap project, would entail massive excavation, and would possibly encroach onto private property.

In designing a project which avoids a lake level reduction, only one feasible option was found. The selected design will involve the application of limestone Rip-Rap by boat. This project is likely to be the first application of Rip-Rap to a lakeshore in Indiana to be performed in this manner. However, the process to be used is not new and has been used in Illinois for several years.

As there is only one known firm with the capability and experience to do this work in this manner, this is to be a single bid project. The firm of Lake Rip-Rap, Inc. of Illinois, will be the contractor for installation. The Daviess-Martin Joint County Parks & Recreation Dept. will serve as the project manager and general contractor, and will supply the construction contractor with the materials for the project by the use of materials subcontractors.

Rip-Rap is a common, effective, and cost effective material for protecting shorelines. There are limits to the cost effectiveness when sites are difficult to access with materials and equipment. These limits are present on the two sites of this project, and typical processes would be cost prohibitive, and at the larger site, impossible.

Despite the unique method of Rip-Rap handling, this project is a simple and straight forward process. The installation contractor has indicated that the entire process should take between 2 and 4 weeks, depending on weather conditions. This short term work duration would make the typical multi-payment invoicing schedule impractical. The need for bonding is also reduced, as the installation subcontractor would be paid only upon completion of the project. Likewise, materials suppliers would not be paid except for materials actually delivered, and that flow would be dependent upon the installation contractor's progress.

## **SITE ONE**

*See Typical Section Drawing In appendix C*

The first of the two sites is a section of lakeshore of approximately 1,500 feet, where there exists an almost vertical slope of between 10 and 30 feet high. Reshaping of the slope to the typical 2/1 profile would require extensive moving of soil, removal of mature timber and would likely encroach upon private lands adjoining the Parks Department lands. For obvious reasons, this is not desirable.

At the base of the slope is a relatively flat "shelf" which has an existing slope averaging between 6:1 and 8:1. This shallow slope configuration would make it impractical to use the typical Rip-Rap cross section, and the typical "toe" trench to a depth of 2 feet below water line.

The location, topography and aspect of this site is such that there is minimal fetch and thus less potential for wave energy development than is common at other parts of West Boggs. For this reason, the plan calls for the Rip-Rap to extend to an elevation of two (2) feet above pool level.

Another cause for the proposed design to be attractive involves the lack of need to lower water levels to perform the work. West Boggs Lake has undergone a complete fisheries renovation, performed by IDNR in 1994. While this renovation is seen as one of the most successful in the state's history, the lake continues to be deficient in aquatic macrophyte communities. Current local management policies include severe limits on lake level reductions, as an effort to protect and encourage macrophyte development.

The concept is to deliver revetment Rip.Rap to a staging area which offers a more suitable work area for trucks and equipment than the actual construction site. That stone will be loaded onto a boat designed specifically for this process. The boat will carry up to 10 tons of material per load, and is equipped with conveyors and other devices to move the material into place. The materials will then be transported across the lake and distributed onto a pre-placed filter fabric at the work site. Some hand shaping of the Rip.Rap will take place to bring the cross section to the configuration shown in the attached typical drawings.

In the spring following the Rip-Rap construction, an interspersed planting of Bald Cypress tree stock will be made along the line of intersection of the two slopes created in the Rip Rap surface. This stock will be planted at intervals of 20 feet. As these trees are expected to have a high level of early mortality, no replanting is planned for lost trees.

## **SITE TWO**

*See Typical Section Drawing In appendix C*

The second site is a more typical example of shoreline erosion at West Boggs, in that it has a vertical slope of some 3-4 feet, and a much longer fetch for wave energy to develop. Approximately 700 lineal feet of lakeshore are involved in this site. This site shares the problem of access to the work area by conventional means. Using the boat-delivered Rip-Rap process here allows the site to be treated without a lake draw down, and without building an access road across a sensitive area. This site however, will be designed with a different section profile, in which the Rip-Rap above water will extend a minimum of three feet in elevation to address the larger wave potential in the area. The below water cross section will be the same as that at site one, and for the same reasons.

In the spring following the Rip-Rap construction, an interspersed planting of Bald Cypress tree stock will be made along the line of intersection of the two slopes created in the Rip-Rap surface. This stock will be planted at intervals of 20 feet. As these trees are expected to have a high level of early mortality, no replanting is planned for lost trees.

## **PERMITS**

*See Correspondence In appendix A*

Permits, letters of permission or waivers have been obtained from the Indiana Department of Natural Resources, Division of Water, the Indiana Department of Environmental Management and the U.S. Army Corps Of Engineers.

A change was added to the project design due to a mandate by the Indiana Department of Environmental Management. Randy Jones of IDEM, who was the project coordinator for that agency, was concerned with the overall design not including any aquatic vegetation introduction.

Mr. Jones felt that we should take another look at replacing the Rip-Rap design with a Bio-Engineering design, and suggested that information on Bio-Engineering could be gained from a particular consultant. Although that idea was not pursued further by the project owner, Jones did require, in conversations with Mike Massonne of IDNR-Soil Conservation, a commitment to use some form of planting in the project. It was understood that the issuing of a Water Quality Certification from IDEM would be dependent on the inclusion of such a planting being added to the design. It should be understood by the reader that no one from IDEM visited the site before setting this requirement, and no biologist or engineer who had visited the site had recommended this type of planting.

To avoid permit delays, it was agreed to plant Bald Cypress within the Rip-Rap field at a later date, probably in 2002, when plants became available for use. That these plants will fail is almost certain, given the history of bio-engineering on reservoirs, and the particular problems with soils at this project site.

## **CONTRACT**

### **GENERAL STATEMENT**

Due to the fact that only one company has been found to provide the type of service the project requires, there is no formal competitive bidding process possible. However, that firm, Lake Rip-Rap, Inc., has provided a quote based on cost per ton of Rip-Rap installed, and a cost per square yard of Filter Fabric placed.

Materials will include Rip-Rap and Filter Fabric, which will be supplied by the Owner under separate contract.

AGREEMENT TEXT

CONTRACT FOR SERVICES

This contract for services is entered into on this 6th day of July, 2001, by and between the Daviess-Martin Joint County Parks and Recreation Department, hereinafter known as Owner, and Lake Rip-Rap Inc., of Girard, Illinois, hereinafter known as Contractor. This contract is for construction of a lake shore stabilization project on West Boggs Lake, as described in a document titled "*West Boggs Lake LARE Shoreline Project Design Summary*", such document incorporated here by reference. This agreement includes both sites 1 and 2 from the design summary document.

The Owner shall pay to the Contractor, a payment for mobilization in the amount of Four Thousand Dollars, (\$4,000.00), upon execution of this instrument. The Owner shall also pay to the Contractor a sum of Twenty Four Dollars (\$24.00) per ton of installed Rip Rap and One Dollar (\$1.00) per square yard of installed filter fabric, to be determined from actual materials invoices from materials suppliers, and from specifications for the work to be performed.

Materials suppliers will be under separate contract with the Owner, and Contractor shall have no responsibility for providing construction materials. Materials required for operation of Contractors equipment and personnel, such as but not limited to, fuel, oil, repair parts and lodging, etc., shall be the responsibility of the Contractor.

The Owner shall not allow prepayment, or partial payments to the Contractor, except for the amount herein prescribed for mobilization, unless the Contractor has provided to the Owner a performance bond in an amount equal to the total cost of the project, or Twenty- Five Thousand Dollars (\$25,000.00), or which ever is more, such bond to be provided at the Contractors expense. Contractor shall, upon completion of the project provide the Owner an invoice for the above identified costs, and shall certify, in writing, that the project is complete and that all specifications have been met. Provided that all specifications have been met and all terms of this contract have been complied with, the Owner shall pay the Contractor, in full, within 60 days of the date or receipt of an invoice.

Contractor shall provide all necessary labor and equipment to install materials provided by the owner, on two separate areas of lake shore on West Boggs Lake, in Daviess County, Indiana, in accordance with and in adherence to the design specifications attached hereto and made a part hereof, subject to inspection and approval by the Owner and/or the Owners representative, such approval not to be unreasonably withheld.

Contractor shall remain liable for any and all environmental damage caused by the Contractor, or by activities, equipment or employees of the Contractor.

Contractor shall restore areas, roadways, parking areas, docks, piers, ramps and other improvements used by the contractor for loading, unloading, and moving equipment, materials handling and storage, or for access to such sites, to a condition equal to or better than the condition in which the sites existed at the beginning of the project.

The Owner shall restore grassy areas and other unimproved surfaces used by the Contractor, to a condition equal to or better than the condition in which the sites existed at the beginning of the project.

The Contractor shall complete all requirements contained herein, no later than October 31, 2001. Failure of the Contractor to comply with the completion date shall cause a penalty to be incurred by the Contractor in the amount of Two Hundred Dollars (\$200.00) per day, for each day the project completion is delayed. Said penalties are to be deducted from any subsequent payments made to the Contractor,



## CONSTRUCTION SPECIFICATIONS

### MATERIALS

#### GEOTEXTILE FABRIC

Before placement of Rip-Rap Armor, both work sites will receive a treatment to include

placement of a Geotextile filter fabric. This material will consist of a polypropylene, staple fiber, needle punched and non-woven Geotextile. The material is resistant to ultraviolet degradation, as well as biological and chemical environments normally found in soils. The material will meet the following minimum specifications.

Values are Stated as Minimum Average Roll Value (MARV) UE

PROPERTY	TEST METHOD	ENGLISH VALUE	METRIC VAL
<b>Mechanical</b>			
Grab Tensile Strength	ASTM 04632	205 lbs	900 N
Grab Elongation	ASTM 04632	50%	50%
Puncture Strength	ASTM 0483	3 110 lbs	485 N
Mullen Burst	ASTM 03786	350 PSI	2410 kPa
Trapezoidal Tear	ASTM 04533	85 lbs	375 N
<b>Hydraulic</b>			
Apparent Opening Size (AOS)	ASTM 04751	80 US Std. Sieve	0.180 mm
Permittivity	ASTM 04491	1.50 sec	1.50 sec
Permeability	ASTM 04491	0.38 cm/sec	0.38 cm/sec
Water Flow Rate	ASTM 04491	110 gpm/ft <sup>2</sup>	4480 l/min/m <sup>2</sup>
<b>Endurance</b>			
UV Resistance	ASTM 04355	70%	70%
(% retained after 500 hours)			

#### RIP-RAP

All Rip-Rap used in this project shall conform to Section 904-04 of the Indiana Standard Specification Handbook.

The material to be used will come from the Abydel Quarry near West Baden, Indiana, owned by Mulzer Crushed Stone, Inc. of Tell City, Indiana. The material has been certified for use as revetment Rip-Rap under the following certification data:

Source: 2682  
Capp Certification: Q 982180  
Material "0" No.: 986160

Under specifications in the Indiana Standard Specification Handbook, this material will have a Top Size of 12 inches (300 mm), with 90 to 100 percent of pieces being below that size, and shall be graded such that the maximum dimension of each piece shall not be greater than three times the minimum dimension.

Revetment Rip-Rap shall have a similar gradation in each loading.

#### MOBILIZATION

Prior to beginning construction, contractor shall bring into the work area, all equipment personnel, supplies and facilities required to allow construction to proceed in a reasonable manner.



## **INSTALLATION PROCESSES**

### **SITE PREPARATION**

#### **Excavation**

The work sites for this project consist of shoreline areas which exhibit significant erosion. Both sites have a stable and gradual fore slope, due to the interactions between wave action and soil conditions.

The back slopes of site one range from 10 to 25 feet in height, with grades approaching vertical. The back slopes at site 2 are also nearly vertical, but extend only 3-4 feet above pool level.

No excavation is intended at either site, leaving both the fore slope and back slope intact in the present configurations.

#### **Trees And Debris Removal**

There are trees, logs and stumps present in the revetment areas, particularly at site 1. The handling of these materials will vary, depending on the size of the material.

Stumps will not be removed, as doing so would cause more disturbance of the base than leaving the stumps in place.

Fallen trees and logs under a six inch diameter, shall be moved and placed on top of the finished revetment.

Fallen trees and logs over a six inch diameter but under a 12 inch diameter shall be loosely covered with Geotextile fabric and covered with Rip Rap.

Fallen trees and logs over a twelve inch diameter and stumps, shall not be removed, but shall have Geotextile fabric fitted closely around and tucked under where possible, and shall have Rip Rap hand placed closely around their edges.

### **CONSTRUCTION**

#### **Geotextile Placement**

The specified Geotextile fabric shall be hand placed ahead of the application of Rip Rap. The material shall be placed so that the top edge of the fabric is located at the elevation specified for the revetment back slope, where it will be pinned into place with steel pins at intervals of 24 inches.

A second row of steel pins will be placed at the elevation of the intersection of the back slope and the fore slope, at intervals of 48 inches.

The remaining width of the Geotextile fabric shall be extended away from the shore, where it will be covered with revetment Rip Rap beyond the fabric edge.

#### **Staging Area**

A staging area will be established at a location remote from the construction sites. This area will be used as a materials storage and handling site, and for the loading of materials onto the watercraft for transport to the construction sites.

Loading of Rip Rap into the watercraft will be performed by a loader or high lift. The material will be removed from storage piles and loaded directly onto the watercraft by this equipment.

#### **Rip Rap Movement**

Rip Rap will be moved across the lake by boat, after having been loaded at the staging area.

#### **Revetment Placement**

Placement of Rip Rap will consist of a combination of unloading from the boat with conveyor equipment, and hand placement in the final position over the Geotextile fabric. Hand shaping will be done as required to cause the finished revetment to conform to the typical drawings for each site.

#### **Site Restoration**

Upon completion of all work at the two construction sites, the staging area will be restored in the following manner:

All roadways, parking areas, docks, piers and other improvements disturbed or damaged by operations of the project, shall be restored by the Contractor, to a condition equal to or better than those same surfaces were prior to mobilization.

All turf , grassy areas and other unimproved surfaces, shall be restored by the Daviess- Martin Joint County Parks & Recreation Department, to a condition equal to or better than those same surfaces were prior to mobilization.

#### **DEMOBILIZATION**

After the Contractor and the Owners representative have agreed that the project is complete and that all specifications have been met, the contractor shall remove all equipment, boats, personnel, supplies and similar components from the area.

### **COST ESTIMATES**

*See cost estimates in Appendix B*

A take-off form of cost estimating has been used to develop an overall cost estimate. Costs for materials and contract services are based on actual quotes from suppliers, while administration costs are estimated.

### **ENGINEERING DATA**

*See Engineering Design Analysis in Appendix C*

Under separate contract, engineering services for the project have been provided by Donan Engineering, Inc. of Jasper, Indiana. Donan not only has extensive knowledge of the proposed design, but also has been the primary engineering data supplier for lake enhancement needs on West Boggs Lake.

- Donan will be providing specific data to do the following evaluations:
- Evaluate the typical sections for stability and site specific suitability.
- Develop wave models for the two sites to determine if typical sections are appropriate.
- Examine and evaluate geological parameters at both sites.
- Determine the parameters for required Geotextile filter.

# **APPENDIX A**

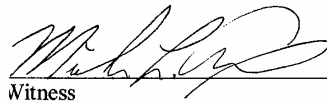
## Temporary Easement For Ingress and Egress

The Washington Boat Club, hereinafter called Grantor, hereby grants to the Daviess-Martin Joint County Parks and Recreation Department, hereinafter called Grantee, a temporary easement to include the following specifications and limitation.

1. This easement will begin upon execution of this instrument, and shall cease two hundred and ten (210) days after the execution of this instrument.
2. The Grantor shall provide the Grantee access over and across the Grantor's property located along Daviess County Road 1200 East, in Daviess County, Indiana, for the purpose of delivering materials, equipment and personnel to a construction staging area to be located on property owned by the Grantee. The proposed construction project includes a shoreline stabilization project to be performed on West Boggs Lake by the Grantee or by a contractor selected by the Grantee.
3. During use of the herein allowed ingress and egress, Grantee shall keep trucks and equipment upon the existing roadways and driveways of the Grantor, or upon alternate routes selected by the Grantor.
4. Grantee shall hold Grantor harmless for any injury, damage or other loss experienced by Grantee or employees or contractors of Grantee, during any and all times such persons, materials or equipment are upon the property of the Grantor.
5. Grantee shall, upon completion of the construction project, repair any damage to roadways, lawns or other facilities located on the real property of the Grantor, where such damage is determined to have been caused by the activities herein allowed, and such damage shall be restored to a condition equal to or better than the condition of the property at the commencement of the construction project.
5. Nothing in this easement shall be construed to create any other condition or agreement between the parties which is not herein included, and no additions, deletions or amendments to this easement shall be allowed unless the same are agreed to by both parties in writing.

This instrument is hereby executed on this 25 day of MAY, 2001.

  
Eugene L. James Commodore  
Authorized Officer of Grantor

 sept. west BOGS  
Witness



**WEST BOGGS PARK**  
DAVIESS-MARTIN JOINT COUNTY  
PARKS & RECREATION DEPARTMENT

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August 7, 2000

Michael W. Neyer, P.E., Director  
IDNR, Div of Water  
402 W. Washington Street, Room W254  
Indianapolis, IN 46204-4160

Dear Mr. Neyer:

Our agency is planning to perform shoreline stabilization on two sites on West Boggs Lake in Daviess County, Indiana. This project is a cooperative effort with IDNR, Soil Conservation, under the LARE program. We are the owner of this lake, but it is public water, therefore we wish to be certain we are performing the work within permit regulations.

The nature of the work is to be the application of Limestone Rip-Rap over a filter fabric material. The two projects involve approximately 2,000 feet of shoreline, and an estimated 1,500 tons of RipRap.

As this technically adds material to the lake, I need to know:

- 1) If this activity falls within the purview of your agency.
- 2) If you will require a permit from your agency. If so, I'll need:
  - a) Copies of any forms for application
  - b) Detailed information as to what you will need to see.

Please respond as quickly as possible to this request for information, so if I need to take further steps to meet your requirements, I can expedite my efforts. We hope to perform this project this fall, after the recreation season, and before winter weather.

Thank you.

Sincerely,

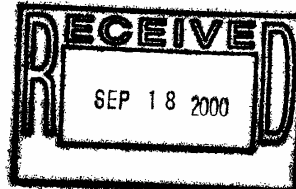
Michael L. Axsom  
Superintendent



Indiana Department of Natural Resources

Frank O'Bannon, Governor  
Larry D. Macklin, Director  
Division of Water  
402 W. Washington Street  
Room W264  
Indianapolis, IN 46204-2748  
PH: (317) 232-4160  
FAX: (317) 233-4579

September 12, 2000  
REC-GN-15,626  
Basin #18



Michael L. Axsom, Superintendent  
West Boggs Park  
Daviess-Martin Joint County Parks & Recreation Department  
P.O. Box 245  
Loogootee, IN 47553

Re: Daviess County-West Boggs Lake

Dear Mr. Axsom:

Reference is made to your letter dated August 7, 2000, regarding the permit requirements for the stabilization of the shoreline along West Boggs Lake. Based on your description, the project site, which lies in the SW  $\frac{1}{4}$ , NE  $\frac{1}{4}$ , NE  $\frac{1}{4}$  of Section 2, Township 3N, Range 5W is located approximately 4,200 feet east of County Road 1200 East and begins 500 feet south of the township line and extends for 800 feet south near Loogootee, Daviess County.

West Boggs Lake is a man-made structure, which was designed and built for the intended purpose of flood control and recreation. This structure was approved by the Natural Resources Commission on June 11, 1970 under Application No. D-2,711. The Department's responsibility with respect to the dam and lake is to insure that it is maintained and functions as a flood control and recreation structure. Based on the plans received with your August 7, 2000 letter, your proposed bank stabilization will not alter or adversely impact the flood control or recreational characteristics of West Boggs Lake. A permit from the Department of Natural Resources is not required for your project as long as the following conditions are followed:

- 1) Revegetate all bare and disturbed areas with a mixture of grasses (excluding all varieties of tall fescue) and legumes as soon as possible upon completion.
- 2) Use minimum average 6 inch graded riprap extended below the normal water level to provide habitat for aquatic organisms in the voids.

Be advised that future work at this site may require permits from the Department of Natural Resources. We recommend that you contact our office prior to commencing any additional construction activity.

Although no permit is required from the Department at this time, your project does lie within the jurisdictional boundaries of the Daviess-Martin Joint County Park and Recreation Board. Any construction activities within the Board's jurisdictional boundaries must be consistent with the Board's approved unit of work and must have the written approval of the Board. You may contact the Daviess-Martin Joint County Park and Recreation Board at the following:

**Daviess-Martin Joint County Park and Recreation Board  
Cledus Stites, Chairman  
P.O. Box 245  
Loogootee, IN 47553**

You may also have to obtain a permit from the Corps of Engineers under Section 404 of the Federal Water Pollution Control Act or Section 10 of the Rivers and Harbors Act. Information relative to the Corps' of Engineers permits may be obtained from:

**U.S. Army Corps of Engineers  
Louisville District Office  
P.O. Box 59  
Louisville, Kentucky 40201  
Telephone (502) 582-5607**

**You should not construe this letter to be a building permit, approval of the proposed project, or a waiver of the provisions of local building or zoning ordinances.**

The Division of Water apologizes for the delayed response and thanks you for this opportunity to be of assistance; your interest in protecting Indiana's natural resources is appreciated. **If you have any questions regarding this letter, please contact Mr. Eric Greulich, Engineering Assistant, in our Technical Services Center, at toll free 1 (877) 928-3755 or (317) 232-4160.**

Sincerely,



Michael W. Neyer, P.E.  
Director  
Division of Water

MWN/elg

pc: Daviess County Plan Commission  
Martin County Plan Commission  
Daviess-Martin Joint County Park and Recreation Board  
Louisville District, Corps of Engineers  
Indiana Department of Environmental Management  
Mike Massonne, IDNR-Soil Conservation  
Bill Maudlin, IDNR-Fish and Wildlife

## Application for Water Quality Certification

Application for Section 401 Water Quality Certification  
Form # 48598 (2-00)

Address all applications or questions to:

**Indiana Department of Environmental Management**  
**Section 401 Water Quality Certification Program**  
100 North Senate Avenue P.O. Box 6015 Indianapolis, Indiana 46206-6015  
1-800-451-6027 or 317-233-8488


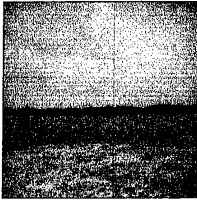
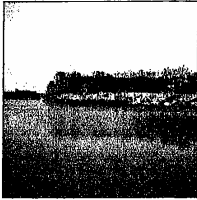
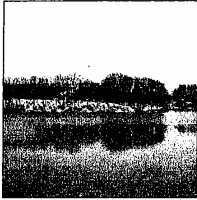
**PLEASE PULL OUT APPLICATION FROM PACKET**

**Failure to provide the information requested in this application may  
result in a delay of processing or denial of your application.**

For office use only
Project Manager:
Date Received:
DEM I.D. Number:
County:



1. APPLICANT INFORMATION		2. AGENT INFORMATION	
Name of Applicant <b>Daviess-Martin Joint County Parks</b>		Name of Agent	
Mailing address (Street/ PO Box/ Rural Route, City, State, Zip) <b>West Boggs Park P.O. Box 245 Loogootee, IN 47553</b>		Mailing address (Street/ PO Box/ Rural Route, City, State, Zip)	
Daytime Telephone Number <b>(812) 295-3421</b>		Daytime Telephone Number	
Fax Number <b>(812) 295-4356</b>		Fax Number	
E-mail address (optional) <b>boggs@dmrtc.net</b>		E-mail address (optional)	
Contact person: (required) <b>Michael L. Axsom, Supt.</b>		Contact person:	
3. PROJECT LOCATION			
County <b>Daviess</b>		Nearest city or town <b>Loogootee, IN</b>	
U.S.G.S. Quadrangle map name (Topographic map) <b>Loogootee</b>		Project street address (if applicable) <b>N/A</b>	
Quarter <b>S/W + N/W + N/E</b>	Section <b>2</b>	Township <b>3N</b>	Range <b>5W</b>
Type of aquatic resource(s) to be impacted (lake, river, stream, ditch, wetland, etc. include name if applicable)  <b>Lake</b>		Project name or title (if applicable) <b>Shoreline Stabilization Project (High Banks)</b>	
		UTM North <b>4285800N</b>	UTM East <b>0505200E</b>
Other location descriptions or driving directions : From U.S. 50, Daviess County Road 1200E 5.6 Miles to North end of West Boggs Lake causeway. Staging area to be located at Washington Boat Club.			
4. PROJECT PURPOSE and DESCRIPTION			
Use additional sheet(s) if required			
Has any construction been started? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>		Anticipated start date <b>April 1, 2001</b>	
If yes, how much work is completed? <b>N/A</b>			
Project purpose and description			
<p>To stabilize approximately 2,000 linear feet of eroding lake shore at two sites on West Boggs by successfully designing and constructing a system of Revetment Rip-Rap structural stabilization. The two sites include approximately 1,300 feet and 700 feet respectively. Included in the scope of this project are considerations for protecting a recently restored fishery and a recovering aquatic habitat, along with solutions to problems dealing with access to the work sites.</p> <p>This project consists of placing Limestone Rip-Rap Revetment on two separate segments of lake shore at West Boggs Lake. Due to special considerations at West Boggs, a number of restrictions have been placed on such operations that restrict options for the methods which may be used.</p> <p>West Boggs Lake has been the subject of fisheries renovation and lake enhancement efforts since 1994. The fishery is currently coming to maturity after the renovation, and it is seen as detrimental to disturb that progress. One major factor in the lake's recovery is the reestablishment of macrophyte communities, which had been decimated almost entirely by the 1994 renovation work.</p> <p>Providing a stable pool level is a necessary factor in allowing macrophyte populations to recover. Drawing down the lake pool level to the degree normally associated with shoreline stabilization work, could have the effect of leaving macrophyte communities exposed to drying and freezing conditions, possibly reversing the recovery which has taken place to date.</p>			

<b>Project Information: Applicants must answer all the following questions.</b>
What are the linear feet of impacts to the waterbody below the ordinary high water mark (OHWM) and/or bank clearing? 100 LF
What is the acreage or square footage of wetlands or other water resources that are proposed to receive a discharge of material (ie. fill), mechanically cleared, or to be excavated? one
What is the area of wetlands or other water resources on the site, in acreage or square feet? 12 Acres
Describe the type, composition and quantity (in cubic yards) of fill material to be placed in the wetland or below the OHWM of the water to receive the material (wetland or other water to be filled). Limestone revetment Rip-Rap will be placed in a volume of about 1,100 Cubic Yards
Describe the type, composition and quantity (in cubic yards) of material proposed to be removed from the wetland or below the HWM of the water resource. one
<b>Drawing/Plan Requirements (applicants must provide the following)</b>
Top/aerial/overhead view of the project site  Cross sectional view  North arrow, scale, property boundaries  Include wetland delineation boundary (if applicable). Label the impact wetlands as I-1, I-2, etc. and mitigation areas as M-1, etc.  Location of all surface waters, including wetlands, proposed works, erosion control measures, existing structures, disposal area for excavated material, fill locations, including quantities, and wetland mitigation (if applicable)  Approximate water depths and bottom configurations (if applicable)  Provide plans on 8 by 11 inch paper, unless directed otherwise
<b>Documentation Requirements (applicants must provide the following)</b>
A Corps of Engineers approved wetland delineation for REC-projects with wetland impacts N/A  Photographs of the project site. Indicate where they were taken on the overhead view of the project plans
<div> Site 2 Picture A</div> <div> Site 2 Picture B</div> <div> Site 1 Picture C</div> <div> Site 1 Picture D</div>

**8. Additional information that MAY be required (IDEM will notify you if needed)**

- a. Erosion control and/or storm water management plans
- b. Sediment analysis
- c. Wetland mitigation plan including: type, size, location, methods of construction, planting and monitoring plans
- d. Species surveys for fish, mussels, plants and threatened or endangered species
- e. Any other information IDEM deems necessary to determine the impact to water quality

**9. Permitting Requirements**

a. Have you applied for an Army Corps of Engineers Section 404 permit? ☒ Yes ☐ No If yes, please supply the Corps of Engineers ID Number, the Corps of Engineers District, the project manager, and a copy of any correspondence with the Corps. **If no, contact the Army Corps of Engineers regarding the possible need for a permit application. (See instructions 11.)**  
**COE ID No.: 200001091-gdn Contact: Gerry Newell, US Army Eng. District, Louisville**

b. Have you applied for, received, or been denied any other federal, state, or local permits, variances, licenses, or certifications for this project? Please give the permit name, agency from which it was obtained, permit number, and date of issuance or denial.  
**IDNR Div. Water granted waiver under their reference No. REC-GN-15,626 on Sept. 12, 2000**

**10. Adjoining Property Owners and Addresses**

List the names and addresses of landowners adjacent to the property on which your project is located and the names and addresses of other persons (or entities) potentially affected by your project. Use additional sheet(s) if required.

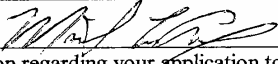
Name Address City	<b>West Boggs Lake Conservation Association</b> <b>RR 3 Box 504-1</b> <b>Loogootee State IN Zip 47553</b>	Name Address City	State Zip
Name Address City	<b>Daviess-Martin Joint County Park Board</b> <b>Rt. 3, Box 522</b> <b>Loogootee State IN Zip 47553</b>	Name Address City	State Zip
Name Address City	State Zip	Name Address City	State Zip
Name Address City	State Zip	Name Address City	State Zip
Name Address City	State Zip	Name Address City	State Zip

**11. Signature - Statement of Affirmation**

I hereby request a Water Quality Certification to authorize the activities described in this application. I certify that I am familiar with the information contained in this application and to the best of my knowledge and belief, such information is true and accurate. I certify that I have the authority to undertake and will undertake the activities as described in this application. I am aware that there are penalties for submitting false information. I understand that any changes in project design subsequent to IDEM's granting of WQC are not covered by the WQC, and I may be subject to civil and criminal penalties for proceeding without proper authorization. I agree

allow representatives of the IDEM to enter and inspect the project site. I understand that the granting of other permits by local, state, or federal agencies does not release me from the requirement of obtaining the WQC requested herein before commencing the project.

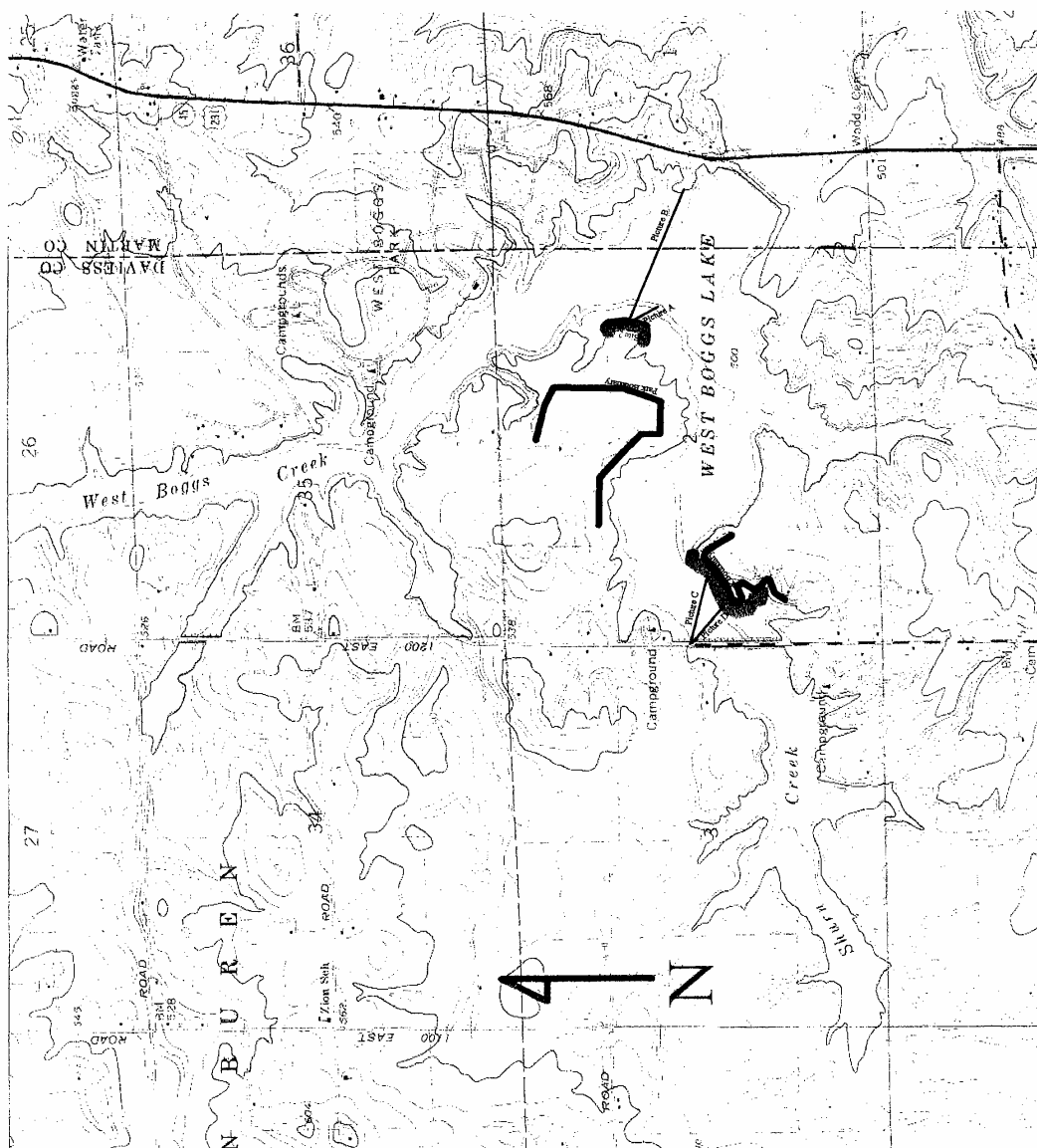
**Instructions continued**

Applicant's Signature:  Date: 2/23/01

Provide information regarding your application to the U.S. Army Corps of Engineers. If you have not contacted the Corps of Engineers, please call the Louisville Corps District at 502/582-5607 or the Detroit Corps District at 313/226-6828. Please consult the map on the next page to determine which district your project is located in.

Provide information regarding any other federal, state, or local permits, variances, licenses, or certifications required for your project. Please indicate whether they were approved, denied, or are pending.

The applicant must sign and date the application.





Indiana Department of Environmental Management  
Office of Water Quality  
Section 401 Water Quality Certification Program

Publication Date:  
March 5, 2001

Closing Date:  
March 26, 2001

## PUBLIC NOTICE

IDEM ID Number:  
2001-107-14-RRJ-A

Corps of Engineers ID Number:  
200001091-gdn

**Interested parties:**

This letter shall serve as a formal notice of the receipt of an application for Section 401 Water Quality Certification by the Indiana Department of Environmental Management (IDEM). The purpose of the notice is to inform the public of active applications submitted for quality certification under Section 401 of the Clean Water Act (33 U.S.C. § 1341) and to solicit comments and information on any issues to water quality related to the proposed project. IDEM will evaluate whether the project complies with Indiana's water quality standards as set forth at 327 IAC 2.

**Applicant:** Daviess-Martin Joint County Parks  
West Boggs Park  
PO Box 245  
Loogootee, IN 47553

**2. Agent:** N/A

**Project location:** T3N, R5W, Section 2, Loogootee Quad, Daviess County.  
North End of West Boggs Lake

**Project waterbody:** West Boggs Lake

**Project Description:** Install geotextile and rip-rap on approximately 2,000 linear feet, at two sites on the lake for shoreline stabilization. Approximately 0.68 acres of the lake is proposed to be filled with rip-rap. No compensatory mitigation is proposed.

**Comment period:** Any person or entity who wishes to submit comments or information relevant to the aforementioned project may do so by the closing date noted above. Only comments or information related to water quality or potential impacts of the project on water quality can be considered by IDEM in the water quality certification review process.

**Hearing:** Any person may submit a written request that a public hearing be held to consider issues related to water quality in connection with the project detailed in this notice. The request for a hearing should be submitted within the comment period to be considered timely. The request should also state the reason for the public hearing as specifically as possible to assist IDEM in determining whether a public hearing is warranted.

**Comments?** Additional information may be obtained from Mr. Randy Jones, Project Manager, at 317-233-2473. Please address all correspondence to the project manager and reference the IDEM project identification number listed on this notice. Indicate if you wish to receive a copy of IDEM's final decision. Written comments and inquiries may be forwarded to -

Indiana Department of Environmental Management  
Section 401 Water Quality Certification Program  
Post Office Box 6015  
Indianapolis, Indiana 46206-6015  
FAX: 317/232-8406

EXHIBIT C

West Boggs Park

2000 LARE Project

TYPICAL SECTION Site 1

47(1) 1:11

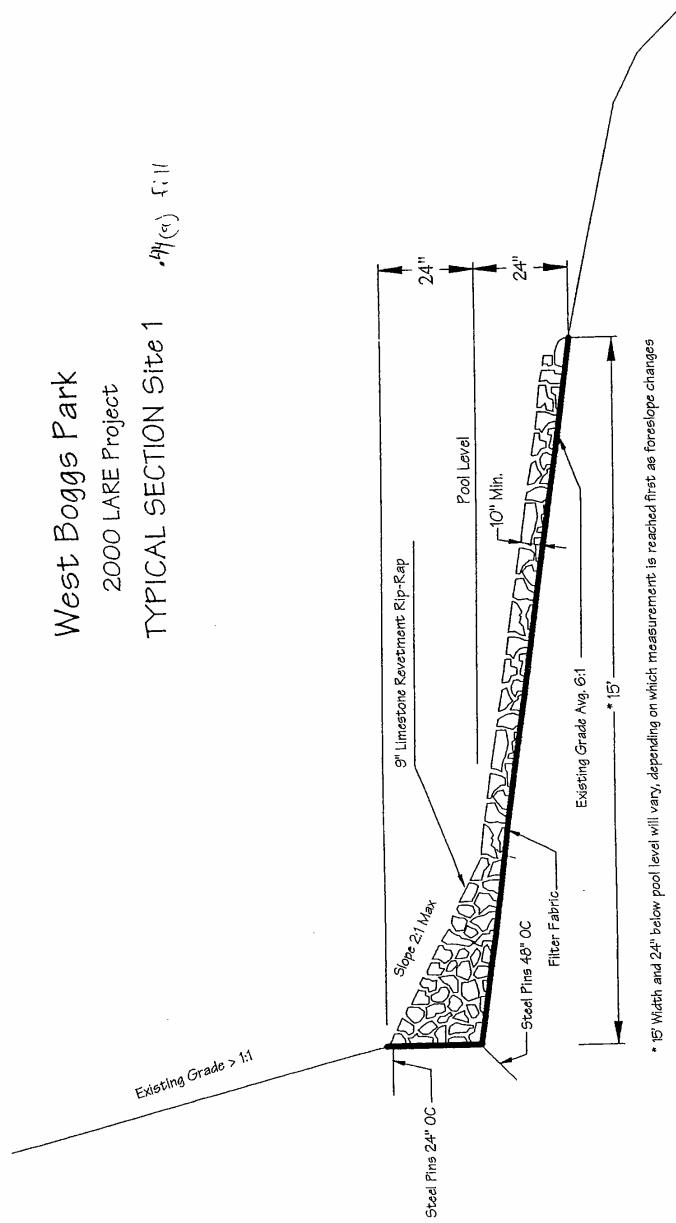
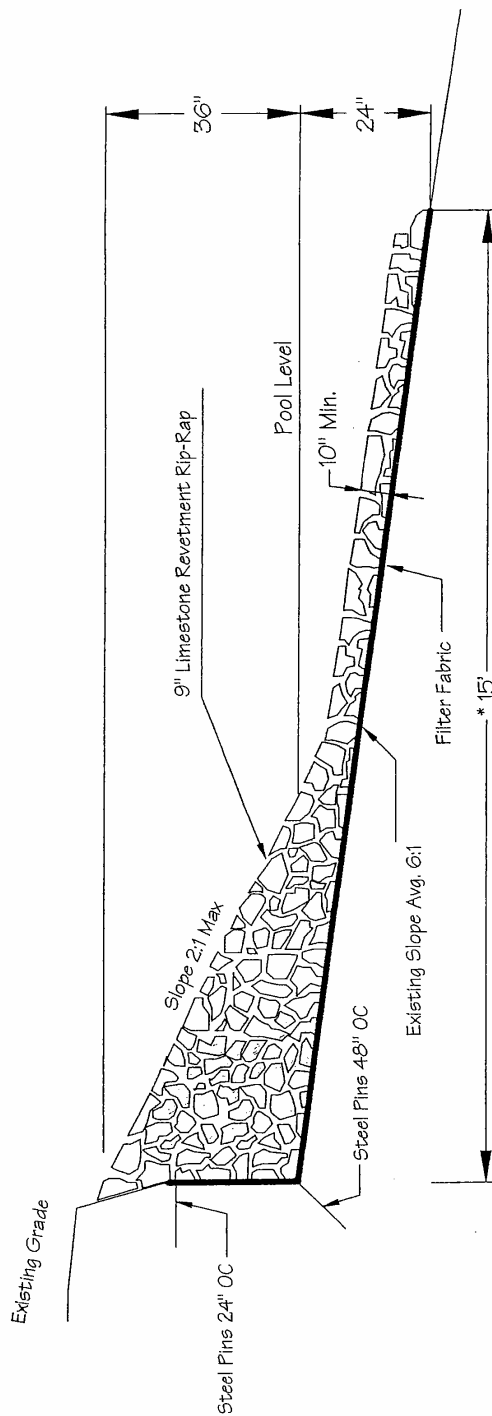


EXHIBIT D

West Boggs Park  
2000 LARE Project  
TYPICAL SECTION Site 2

2/9/01



\* 15' Width and 24" below pool level will vary, depending on which measurement is reached first as foreslope changes





# INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

*We make Indiana a cleaner, healthier place to live*

Frank O'Bannon  
Governor

MAY 3, 2001

Lori F. Kaplan  
Commissioner

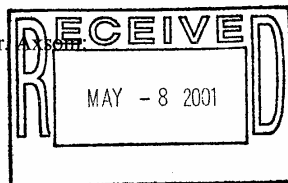
100 North Senate Avenue  
P.O. Box 6015  
Indianapolis, Indiana 46206-6015  
(317) 232-8603  
(800) 451-6027  
[www.state.in.us/idem](http://www.state.in.us/idem)

VIA CERTIFIED MAIL 7000 0520 0023 5043 4052

00-2D

Mr. Michael Axsom  
Daviess-Martin Joint County Parks  
West Boggs Park  
PO Box 245  
Loogootee, IN 47553

Dear Mr. Axsom:



Re: Section 401 Water Quality Certification  
Project: Shoreline Stabilization  
IDEM ID #: 2001-107-14-RRJ-A  
COE ID #: 200001091-gdn  
County: Daviess

Office of Water Quality staff have reviewed your application received February 26, 2001, requesting Section 401 Water Quality Certification. You propose to install geotextile and rip-rap along approximately 2,000 linear feet of the shoreline of West Boggs Lake for stabilization.

Based on the available information, it is the judgment of this office that the proposed project will comply with the applicable provisions of 327 IAC 2 and Sections 301, 302, 303, 306, and 307 of the Clean Water Act if the permittee complies with the conditions set forth below. Therefore, subject to the following conditions, the Indiana Department of Environmental Management (IDEM) hereby grants Section 401 Water Quality Certification for the project described in your application received February 26, 2001. Any changes in project design or scope not detailed in the application described above or modified by the conditions below are not authorized by this certification. The permittee shall:

## CONDITIONS:

1. Deposit any dredged material in a contained upland disposal area to prevent sediment run-off to any waterbody. Dispose of all dredged and excavated material according to the requirements of 329 IAC 10, governing Solid Waste Land Disposal Facilities. Your project information may be forwarded to the IDEM Office of Land Quality, Industrial Waste Section for review. Sampling may be required to determine if the dredged sediment is contaminated. Failure to properly

dispose of contaminated sediment may result in enforcement action against you.

2. Install erosion control methods prior to any soil disturbance to prevent soil from leaving the construction site. Appropriate erosion control methods include, but are not limited to, straw bale barriers, silt fencing, erosion control blankets, phased construction sequencing, and earthen berms. Monitor and maintain erosion control structures and devices regularly, especially after rain events, until all soils disturbed by construction activities have been permanently stabilized.
3. Clearly mark the construction limits shown in the attached plans at the project site during construction.
4. Allow the commissioner or an authorized representative of the commissioner (including an authorized contractor), upon the presentation of credentials:
  - A) to enter upon the permittee's property;
  - B) to have access to and copy at reasonable times any records that must be kept under the conditions of this certification;
  - C) to inspect, at reasonable times, any monitoring or operational equipment or method; collection, treatment, pollution management or discharge facility or device; practices required by this certification; and any wetland mitigation site;
  - D) to sample or monitor any discharge of pollutants or any mitigation site.

This granting of Section 401 Water Quality Certification does not relieve the permittee from the responsibility of obtaining any other permits or authorizations that may be required for this project or related activities from IDEM or any other agency or person. You may wish to contact the Indiana Department of Natural Resources at 317/ 232-4161 concerning the possible requirement of natural freshwater lake or floodway permits, or the IDEM stormwater permits section at 317/232-8648 concerning the possible need for 327 IAC 15-5 (Rule 5) permits if you plan to disturb greater than 5 acres of soil during construction.

This certification does not:

- (1) authorize impacts or activities outside the scope of this certification;
- (2) authorize any injury to persons or private property or invasion of other private rights, or any infringement of federal, state or local laws or regulations;
- (3) convey any property rights of any sort, or any exclusive privileges;
- (4) preempt any duty to obtain federal, state or local permits or authorizations required by law for the execution of the project or related activities; or
- (5) authorize changes in the plan design detailed in the application.

Failure to comply with the terms and conditions of this Section 401 Water Quality Certification may result in enforcement action against the permittee. If an enforcement action is pursued, the permittee could be assessed up to \$25,000 per day in civil penalties. The permittee may also be subject to criminal liability if it is determined that the Section 401 Water Quality Certification was violated willfully or negligently.

This certification is effective 18 days from the mailing of this notice unless a petition for review and a petition for stay of effectiveness are filed within this 18-day period. If a petition for review and a petition for stay of effectiveness are filed within this period, any part of the permit within the scope of the petition for stay is stayed for 15 days, unless or until an Environmental Law Judge further stays the permit in whole or in part.

This decision may be appealed in accordance with IC 4-21.5, the Administrative Orders and Procedures Act. The steps that must be followed to qualify for review are:

1. You must petition for review in a writing that states facts demonstrating that you are either the person to whom this decision is directed, a person who is aggrieved or adversely affected by the decision, or a person entitled to review under any law.
2. You must file the petition for review with the Office of Environmental Adjudication (OEA) at the following address:

Office of Environmental Adjudication  
ISTA Building  
150 West Market Street  
Suite 618  
Indianapolis, IN 46204

3. You must file the petition within eighteen (18) days of the mailing date of this decision. If the eighteenth day falls on a Saturday, Sunday, legal holiday, or other day that the OEA offices are closed during regular business hours, you may file the petition the next day that the OEA offices are open during regular business hours. The petition is deemed filed on the earliest of the following dates: the date it is personally delivered to OEA; the date that the envelope containing the petition is postmarked if it is mailed by United States mail; or, the date it is shown to have been deposited with a private carrier on the private carrier's receipt, if sent by private carrier.

Identifying the permit, decision, or other order for which you seek review by number, name of the applicant, location, or date of this notice will expedite review of the petition.

Note that if a petition for review is granted pursuant to IC 4-21.5-3-7, the petitioner will, and any other person may, obtain notice of any prehearing conferences, preliminary hearings, hearings, stays, and any orders disposing of the proceedings by requesting copies of such notices from OEA.

If you have procedural questions regarding filing a petition for review you may contact OEA at 317-232-8591.

If you have any questions about this certification, please contact Randy Jones, Project

Manager, of my staff at 317/ 233-2473, or you may contact the Office of Water Quality through the IDEM Environmental Helpline (1-800-451-6027).

Sincerely,

A handwritten signature in black ink, appearing to read "Matt C. Rueff", written over a horizontal line.

Matthew C. Rueff  
Assistant Commissioner  
Office of Water Quality

cc: Gerry Newell, COE- Louisville District  
Mike Litwin, USFWS  
Gary Jordan, IDNR  
Mike Massonne, IDNR- Division of Soil Conservation



**WEST BOGGS PARK**  
DAVIESS-MARTIN JOINT COUNTY  
PARKS & RECREATION DEPARTMENT

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August 7, 2000

U.S. Army Corps of Engineers  
Louisville District Office  
P.O. Box 59  
Louisville, KY 40201

Dear COE:

Our agency is planning to perform shoreline stabilization on two sites on West Boggs Lake in Daviess County, Indiana. We are the owner of this lake, but it is public water, therefor we wish to be certain we are performing the work within regulations.

The nature of the work is to be the application of Limestone Rip-Rap over a filter fabric material. The two projects involve approximately 2,000 feet of shoreline, and an estimated 1,500 tons of RipRap.

As this technically adds material to the lake, I need to know:

- 1) If this activity falls within the purview of COE
- 2) If you will require a permit from your agency. If so, I'll need:
  - a) Copies of any forms for application
  - b) Detailed information as to what you will need to see.

Please respond as quickly as possible to this request for information, so if I need to take further steps to meet your requirements, I can expedite my efforts. We hope to perform this project this fall, after the recreation season, and before winter weather.

Thank you.

Sincerely,

Michael L. Axsom  
Superintendent



**DEPARTMENT OF THE ARMY**

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE  
CORPS OF ENGINEERS

P.O. BOX 59  
LOUISVILLE, KENTUCKY 40201-0059  
FAX: (502) 582-5072

October 11, 2000

Operations Division  
Regulatory Branch (North)  
ID No. 200001091-pjl

Mr. Michael L. Axsom  
West Boggs Park  
Daviess-Martin Joint County  
Parks & Recreation Department  
P.O. Box 245  
Loogootee, Indiana 47553

Dear Mr. Axsom:

This is in response to your letter of August 7, 2000, concerning a jurisdictional determination for work proposed on West Boggs Lake in Daviess County, Indiana.

The above referenced site contains "waters of the United States." This preliminary determination is based on the presence of (1) a navigable waterway; (2) wetlands adjacent to navigable or interstate waters, or that would eventually drain or flow into navigable or interstate waters through a tributary system that may include man-made conveyances such as ditches or channelized streams; (3) one or more tributaries (stream channels, man-made conveyances, lakes, ponds, rivers) that eventually drain or flow into navigable or interstate waters; (4) other waters such as isolated lakes, ponds, wetlands or abandoned mining pits, the use, degradation or destruction of which could affect interstate or foreign commerce.

The Corps of Engineers exercises regulatory authority under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) and Section 404 of the Clean Water Act (33 USC 1344). The data you furnished indicates an authorization under one or both of these Sections of law may be required before you begin the work. However, the information given is insufficient for us to be certain of the need for a permit on this particular proposal. We will need additional detail on the project's design, scope, construction methods, and purpose in order to determine whether a permit is required.

We have found it is usually in the applicant's best interest to submit that data in a formal permit application. Should an individual permit be required, we can then begin processing your request immediately.

Enclosed is a packet which contains the information and forms needed to apply for a Department of the Army (DA) permit. Currently, the processing time for noncontroversial applications requiring individual review takes approximately 90 days. Please allow sufficient time in your preconstruction schedule for the processing of a DA permit application.

(502) 582-6461.

Sincerely,

  
for Pam Loeffler  
Regulatory Specialist  
Regulatory Branch

Enclosures



**WEST BOGGS PARK**  
DAVIESS-MARTIN JOINT COUNTY  
PARKS & RECREATION DEPARTMENT

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October 17, 2000

Pam Loeffler, Regulatory Specialist  
Operations Division  
Regulatory Branch (North)  
Department of the Army  
U.S. Army Engineer District, Louisville  
Corps of Engineers  
P.O. Box 59  
Louisville, Kentucky 40201-0059

Dear Ms. Loeffler:

This is in reply to your letter of October 11, 2000, concerning additional information to determine the need for a permit for a project at West Boggs Lake. I am well aware of the fact that the Corps exercises regulatory authority under the acts cited in your response; that's why I wrote to you in the first place.

I also understand your suggestion that providing the detailed information with a formal permit application would allow immediately beginning the 90 day review process. However, in 90 days it will be mid-January here in Indiana, and the project could not proceed anyway. I have decided to forward information without the application at this time. If it becomes necessary, I can do that later, since we will then have missed our opportunity to do the project this year anyway.

We are attempting to fit this into a very tight window of opportunity for construction this fall, and if that proves not possible, we can apply for a permit over winter. Actually, this is the same thinking I had when I mailed the informal inquiry in early August. Considerations of weather conditions, seasonal water levels, and interference with recreational use, limit the times of year when this work can be done.



October 17, 2000

Due to our need to proceed with haste, and with regard to the fact that this is an environmental protection project, and not a resource exploitation project, I am requesting the expediency of one of the "alternate forms of authorization" indicated in the Department of the Army's Regulatory Program Overview.

I note the language from that DA document which states, "**Letters of permission may be used where, in the opinion of the district engineer, the proposed work would be minor, not have significant individual or cumulative impact on environmental values, and should encounter no appreciable opposition.**" It would appear our project is a good fit for that process. This is also similar to the position taken by the Indiana Department of Natural Resources, Division of Water on this project.

With such an authorization, we could still get work started in this calendar year. If that becomes impossible, further planning for a new time table is subject to being less hurried, meaning time could be allowed for the more lengthy permitting process.

To support this request for using the Letter Of Permission rather than the individual permit, I am enclosing the same draft design summary which was provided to the Indiana Department of Natural Resources. One item in that summary is the correspondence from the Indiana Division of Water, in which they determined a permit was not required from their office. Also included are, I think, all the data your letter indicates you might need to determine if a permit is necessary.

If, after looking over this data, you decide a permit will be required, I'll look forward to having that decision as early as possible. If that is the case, we will begin restructuring our plans around that decision, with full expectation of delaying the project until at least next Fall. Alternately, we may simply decide to scrap the project altogether, as such a delay would require refreshing our budget to include changes in costs. I fail to see how any of that would better serve either of our missions.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Michael L. Axsom', written over a horizontal line.

Michael L. Axsom  
Superintendent



WEST BOGGS PARK  
DAVIESS-MARTIN JOINT COUNTY  
PARKS & RECREATION DEPARTMENT

---

February 1, 2001

Pam Loeffler, Regulatory Specialist  
Operations Division  
Regulatory Branch (North)  
Department of the Army  
U.S. Army Engineer District, Louisville  
Corps of Engineers  
P.O. Box 59  
Louisville, Kentucky 40201-0059

Dear Ms. Loeffler:

In October of last year, I received a letter from your office regarding my earlier inquiry about a permit. I sent another request for information, after receiving your letter of October 11, 2000, but to date have had no response.

Since there was no response to my last inquiry after more than 90 days, I must assume that your agency has determined that a formal permit application is required. To that end, I am enclosing an application 33 CFR 325 for this project. Also enclosed is the entire draft project design summary. I am not enclosing a permit fee, as my reading of your information indicates fees do not apply to local government agencies. If that is not correct, please let me know.

Please initiate the permit process for this application at the earliest possible date. I will try to provide any additional information requested.

As per your previous letter, we will expect a response to this application within 90 days, unless we have heard from your office that additional information is needed. After that time, I assume I will have no choice but to announce that the project has been scrapped due to failure to obtain a permit. If that happens, the funding for the project will cease to be available, and I will probably not seek it again. I believe the COE is the best source of information on the need and priority for this type conservation work. If the COE feels it is not important, I see no reason we should worry about it in the future.

Sincerely,

Michael L. Axsom  
Superintendent



**DEPARTMENT OF THE ARMY**  
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE  
CORPS OF ENGINEERS  
P.O. BOX 59  
LOUISVILLE, KENTUCKY 40201-0059  
FAX: (502) 315-6677  
February 16, 2001

Operations Division  
Regulatory Branch (North)  
ID No. 200001091-gdn

Mr. Michael L. Axsom  
West Boggs Park  
Daviess-Martin Joint County  
Parks & Recreation Department  
P.O. Box 245  
Loogootee, Indiana 47553

Dear Mr. Axsom:

This is our preliminary response to your request for Department of the Army authorization to install approximately 2,000 linear feet of riprap bank stabilization along the shoreline of West Boggs Lake at two locations in Daviess County, Indiana. Authorization is required in accordance with Section 10 of the Rivers and Harbors Act of 1899 and/or Section 404 of the Clean Water Act (CWA).

Under Section 10 and Section 404 the Louisville and Detroit Districts issued Regional General Permit (RGP) No. 1 on February 11, 2000, for certain activities having minimal impact in Indiana. However, a site specific individual Section 401 Water Quality Certification (WQC) must be granted by the Indiana Department of Environmental Management (IDEM) for the proposed project prior to final approval by this office.

We have determined that your proposed work could be considered for the RGP. Your request is currently being reviewed for compliance with the RGP conditions. However, our review will not be complete until we receive a copy of the individual WQC from either you or the IDEM, including any revised project plans. Once we receive a copy of the WQC and revised plans (if any) we will complete our review. I have enclosed a copy of our Public Notice announcing the issuance of the RGP and a copy of the Section 401 Water Quality Certification which contains the IDEM Notification Form.

If we determine that the work qualifies for the RGP, our verification letter would include the RGP General Conditions, the WQC and any Special Conditions that may be necessary to reduce the impacts to the aquatic site to the minimum level. **You may not begin construction until you receive the verification letter from us.** The verification letter will be issued within 45 days from our receipt of IDEM's individual WQC unless we determine the project has more than minimal impact.

Copies of this letter will be sent to the appropriate coordinating agencies (see enclosure for addresses).

If you have any questions concerning this matter, please contact this office at the above address, ATTN: CELRL-OP-FN or call me at (502) 315-6683. Any correspondence on this matter should refer to our ID Number 200001091-gdn.

Sincerely,

A handwritten signature in cursive script that reads "Gerry Newell".

Gerry Newell  
Project Manager  
Regulatory Branch

Enclosure

ADDRESSES FOR COORDINATING AGENCIES

Mr. Dennis Clark  
Section Chief  
Section 401 Water Quality Certification Program  
Indiana Department of Environmental Management  
P.O. Box 6015  
Indianapolis, Indiana 46206-6015

Mr. Mike Neyer, P. E.  
Director  
Division of Water  
Indiana Department of Natural Resources  
402 West Washington Street, Room W264  
Indianapolis, Indiana 46204



**DEPARTMENT OF THE ARMY**

U.S. ARMY ENGINEER DISTRICT, LOUISVILLE  
CORPS OF ENGINEERS  
P.O. BOX 59  
LOUISVILLE, KENTUCKY 40201-0059  
FAX: (502) 315-6677

July 20, 2001

Operations Division  
Regulatory Branch (North)  
ID No. 200001091-gdn

Mr. Michael L. Axsom  
West Boggs Park,  
Daviess-Martin Joint County  
Parks & Recreation Department  
P.O. Box 245  
Loogootee, Indiana 47553

Dear Mr. Axsom:

This is in response to your request for a Department of the Army Permit to install approximately 2,000 linear feet of riprap bank stabilization along the shoreline of West Boggs Lake in Daviess County, Indiana.

Under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA), the Louisville and Detroit Districts issued Regional General Permit (RGP) No. 1 on February 11, 2000, for certain activities having minimal impact in Indiana. We have verified that your proposed work shown on the enclosed plans and described below is authorized under the RGP. Therefore, you may proceed with the work subject to the enclosed general conditions, the Indiana Department of Environmental Management (IDEM) Section 401 Water Quality Certification dated (WQC) May 3, 2001, and any noted special conditions.

Special Conditions: none.

Any new construction activity other than that shown on the plans submitted may not qualify for the RGP. If your plans change or if additional activities are proposed, please submit revised plans to this office for review prior to construction.

Also enclosed is a "Notice of Authorization" to be displayed at the construction site in a conspicuous place. Upon completion of the work authorized by this RGP, the enclosed Completion Report form must be completed and returned to this office. This authorization is valid until **February 11, 2005**.

Copies of this letter will be sent to the appropriate coordinating agencies (see enclosure for addresses).

If you have any questions concerning this matter, please contact this office at the above address, ATTN: CELRL-OP-FN or call me at (502) 315-6683. Any correspondence on this matter should refer to our ID Number 200001091-gdn.

Sincerely,

A handwritten signature in cursive script that reads "Gerry Newell".

Gerry Newell  
Project Manager  
Regulatory Branch

Enclosures

ADDRESSES FOR COORDINATING AGENCIES

Mr. Dennis Clark  
Section Chief  
Section 401 Water Quality Certification Program  
Indiana Department of Environmental Management  
P.O. Box 6015  
Indianapolis, Indiana 46206-6015

Mr. Mike Neyer, P. E.  
Director  
Division of Water  
Indiana Department of Natural Resources  
402 West Washington Street, Room W264  
Indianapolis, Indiana 46204



**GENERAL CONDITIONS:**

1. Discharges of dredged or fill material into waters of the United States must be minimized or avoided to the maximum extent practicable at the project site (i.e. on-site). The permittee shall provide a mitigation/monitoring plan for any activity where the adverse impact on special aquatic sites exceeds 0.10 acre (4,356 sq. ft.) or is determined to be more than minimal impact. In determining the minimal impact threshold, the Districts will consider the direct and secondary impacts of the fill or work and any mitigation measures. A wetland delineation report is also required. NOTE: An important element of any mitigation plan for projects in or near streams, other open waters and wetlands is the requirement for vegetated buffers. Therefore, all mitigation plans should include a minimum 50-foot wide buffer between the edge of the project site and the waters and/or wetlands to be affected unless a lesser distance has been specifically approved under the RGP.
2. The permittee shall, if mitigation is required, develop the mitigation site concurrently with site construction. This will assure that aquatic functions are not lost for long periods of time which could adversely affect water quality and wildlife.
3. The permittee shall ensure that sedimentation and soil erosion control measures are in place prior to any construction activity. This shall include the installation of straw bale barriers, silt fencing and/or other approved methods to control sedimentation and erosion.
4. The permittee shall ensure that areas disturbed by any construction activity, including channel banks, are immediately stabilized and revegetated with a combination of grasses, legumes and shrubs compatible to the affected area.
5. The permittee shall ensure that all in-stream construction activity is not performed during periods of high stream flow or during the fish spawning season between April 1 through June 30 without first contacting the IDNR, Division of Fish and Wildlife for their expertise on impacts to the fishery resource. Additionally, the discharge of dredged and/or fill material in known waterfowl breeding areas must be avoided to the maximum extent practicable.
6. The permittee will ensure that the activity authorized will not disrupt movement of those aquatic species indigenous to the waterbody, including those species which normally migrate through the area unless the activity's specific purpose is to impound water.
7. The permittee shall ensure that all construction equipment is refueled and maintained on an upland site away from existing streams, drainageways and wetland areas. Heavy equipment working in wetlands must be placed on mats, or other measures taken to minimize soil disturbance.
8. The permittee must provide a copy of the site specific State Section 401 WQC before the Corps will authorize a project under the RGP.
9. The permittee must comply with any case specific special conditions added by the Corps or by the State Section 401 WQC. The conditions imposed in the State Section 401 WQC are also conditions of this RGP.
10. The permittee shall assure that no activity authorized by the RGP may cause more than a minimal adverse effect on navigation.
11. The permittee shall ensure proper maintenance of any structure or fill authorized by this RGP, including maintenance to ensure public safety.
12. The permittee shall not perform any work within any Wild and Scenic Rivers or in any river officially designated as a "study river" for possible inclusion in the system, unless the appropriate Federal agency, with direct management responsibility for such river, has determined in writing that the proposed activity authorized by the RGP will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal Land Management agency in the area (e.g. U.S. Forest Service, Bureau of Land Management or the U.S. Fish and Wildlife Service).
13. The permittee shall not perform any work under the RGP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act, or which is likely to destroy or adversely modify the critical habitat of such species. The permittee shall notify the District Engineer if any listed species or critical habitat might be affected or is in the vicinity of the project, and shall not begin work under the RGP until notified by the District Engineer that the requirements of the Endangered Species Act have been satisfied and that the activity is authorized. Authorization of an activity under the RGP does not authorize the "take" of a threatened or endangered species as defined under the Federal Endangered Species Act. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, both lethal and non-lethal "takes" of protected species are in violation of the Endangered Species Act.



**This notice of authorization must be conspicuously  
displayed at the site of work.**

United States Army Corps of Engineers

JULY 20, 2001

A permit to: PLACE APPROXIMATELY 2,000 LINEAR FEET OF RIPRAP FOR BANK STABILIZATION,  
at: WEST BOGGS LAKE, IN DAVIESS COUNTY, INDIANA

has been issued to: DAVIES-MARTIN COUNTIES PARKS & RECREATION DEPARTMENT

ADDRESS OF PERMITTEE: P.O. BOX 245  
LOOGOOTEE, INDIANA 47553

**Permit No. 20001091**

ROBERT E. SLOCKBOWER  
COLONEL, CORPS OF ENGINEERS

District Commander

ENG FORM 4336, JUL 81 (ER 1145-2-309) EDITION OF JUL 70 MAY BE USED

(Proponent: DAEM-CWO)

**Compliance Certification:**

**Permit Number:** ID NO. 200001091-gdn

**Name of Permittee:** Michael L. Axsom

**Date of Issuance:** July 20, 2001

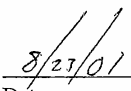
Upon completion of the activity authorized by this permit and any mitigation required by this permit, sign this certification and return it to the following address:

U.S. Army Corps of Engineers  
CELRL-OP-FN  
P.O. Box 59  
Louisville, Kentucky 40201

Please note that your permitted activity is subject to a compliance inspection by an U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

  
\_\_\_\_\_  
Signature of Permittee

  
\_\_\_\_\_  
Date

## **APPENDIX B**

## Project Budget

[illegible]

## **APPENDIX C**

# Donan Engineering, Inc.

JOHN G. DONAN, JR., P.E., PRESIDENT



4342 North U.S. 231  
Jasper, TN 37546  
Phone (812) 482-5611 Fax (812) 482-9165  
Toll Free (800) 482-5611  
www.donan.com

September 5, 2000

Mike Axsom  
West Boggs Park  
P.O. Box 245  
Loogootee, Indiana 47553

RE: Shoreline Stabilization Design/Construction Project  
Design Analysis

Dear Mr. Axsom:

At your request, we are providing an estimate for design analysis of the Lake Rip Rap, Inc. Typical Section for West Boggs Park. That typical design cross section is representative of the method you intend for Lake Rip Rap, Inc. to employ as shoreline stabilization measures at two separate areas of West Boggs Lake.

It is my understanding that Donan's scope of service for this project would be limited to evaluating this typical design to predict the effectiveness and stability of the typical design. Our evaluation and analysis will include the following:

1. Determine specifications for geotextile material. This is to include predicting the inherent bearing capacity of underlying soils and providing design requirements for the geotextile material to provide adequate separation and filtration.
2. Specify the design wave height applicable for the construction area and the corresponding height of the riprap backslope to be constructed.
3. Specify the gradation and thickness of riprap to be used on the foreslope.

*Engineering • Architecture • Planning • Surveying • Geology • Environmental • Safety & Health*

*Jasper IN • Evansville IN • Indianapolis IN • Louisville KY • Madisonville KY • Lexington KY*

The evaluation and analysis, as described above, is to be supplied in a report format and certified by a Professional Engineer registered in the State of Indiana. Our fee for this service is to be based on time and materials estimated to range from \$2,000.00 to \$3,000.00.

Enclosed find our standard short form agreement for this service. Please sign the agreement and return the original and yellow copies to our office. Don't hesitate to contact me if you have questions or comments. We appreciate your confidence in our service and continue to appreciate the opportunity to provide our services to the Daviess-Martin Joint County Parks & Recreation Department.

Sincerely,

Donan Engineering, Inc.



Edward J. Knust

Senior Environmental Project Manager

Encl.



# Donan Engineering, Inc.

JOHN G. DONAN, JR., P.E., PRESIDENT



4342 North U.S. 231  
Jasper, IN 47546  
Phone (812) 482-5611 Fax (812) 482-9165  
Toll Free (800) 482-5611  
www.donan.com

October 2, 2000

Mike Axsom  
West Boggs Lake  
P.O. Box 245  
Loogootee, IN 47553

RE: Shoreline Stabilization  
Non-Standard Design Analysis

Dear Mr. Axsom:

At your request, Donan Engineering Inc. has performed a design analysis of the method you intend to utilize for shoreline stabilization at two locations on West Boggs Lake. The method referenced is represented by two typical detail drawings provided by you and entitled West Boggs Park 2000 LARE Project Typical Section Site 1 and West Boggs Park 2000 LARE Project Typical Section Site 2. The locations of these two sites are represented by a map entitled Shoreline Stabilization Project that you also provided. The design analysis evaluated the proposed method according to three criteria including:

- Features required of the geotextile fabric for the application.
- Height of backslope and extent of foreslope protection required to stabilize and protect the shoreline from wind generated waves.
- Gradation and thickness of riprap required to maintain stability.

The significant wave height associated with wind was determined for Site 2 to represent the critical erosion situation. Critical features of the proposed typical section for Site 2 include 2:1 backslope protection to 36" above pool, 6:1 foreslope protection to 24" below pool, 9" revetment riprap, and foreslope minimum thickness of 10". Based on guidelines found in USDA-NRCS Technical Release 69, RIPRAP DESIGN FOR PROTECTING SLOPES AGAINST WAVE ACTION, the features represented for Site 2 were found to be adequate for protecting the shoreline from wind generated wave induced erosion.

This evaluation did not examine the adequacy of the proposed shoreline protection from boat generated waves.

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The upper level elevation requiring protection at Site 2 was found to be less than 2.0 feet above normal pool. The typical design proposed for Site 1 then, is believed to be adequate as the open water distances are significantly less than for Site 2. Site 1 is in an area of restricted speed such that the 24" height of the backslope is adequate protection against both boat generated and wind generated wave.

The following pages detail the requirements for the geotextile and the features of the riprap slope required. Attached to this evaluation are:

- Typical Section Site 1
- Typical Section Site 2
- Climatological Data
- Site Map
- Topographic Map showing Radians

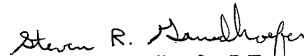
We appreciate your confidence in our service. Don't hesitate to contact our office if you have questions or comments.

Sincerely,

Donan Engineering, Inc.



Edward J. Knust  
Senior Environmental Project Manager

  
Steven R. Grundhoefer, P.E.

Encl.



West Boggs Lake  
Shoreline Stabilization  
Design Analysis

**Introduction**

A non-standard method of shoreline stabilization is proposed for specific areas of West Boggs Lake. The methodology proposed involves the placement of geotextile fabric and riprap on eroded areas of the shoreline. Targeted eroded areas have exposed backslope areas with slopes greater than or equal to 1:1 and submerged foreslope areas typically averaging approximately 6:1 slopes. The method includes pinning geotextile from the shore lakeward fifteen feet (15') on the foreslope and up the backslope to an elevation two feet (2') above pool level at Site 1 and three feet (3') above pool level at Site 2. Revetment riprap is then conveyed from a boat and distributed to the backslope being placed at a slope no steeper than 2:1. Riprap is conveyed and distributed to the foreslope maintaining a minimum thickness of ten inches (10").

The intent of this design analysis is to evaluate the proposed method according to three criteria including:

- Suitability of the geotextile fabric for the application.
- Height of backslope and extent of foreslope protection required to stabilize and protect the shoreline from wave action generated by boats and wind.
- Gradation and thickness of riprap required to maintain stability.

**Suitability of the geotextile fabric for the application.**

Geotextile fabrics are utilized in a variety of applications to provide singular or multiple functions. Though these functions can overlap they can be categorized into the following concepts that include separation, reinforcement, filtration, drainage, and moisture barrier. In this application, the geotextile fabric functions of concern include separation, reinforcement, and filtration.

Separation

The geotextile must have sufficient fabric strength to resist bursting associated with the stress applied to the fabric. A formula for required fabric burst strength is the following:

$$T_{req} = p' d_v$$

Where

$T_{req}$  = the required fabric strength  
 $p'$  = the stress at the fabric's surface  
 $d_v$  = the maximum void diameter =  $0.4 d_a$   
 $d_a$  = the average stone diameter

The stress applied to the fabric in the proposed application is limited to the weight of the riprap and the water such that  $p'$  is approximately 2.01 psi. The average stone diameter ( $d_a$ ) is assumed as 9 inches, therefore,

$$T_{req} = 2.01 \text{ psi} \times 9 \times 0.4 = 7.2 \text{ psi}$$

Typical puncture strengths range from 10-100 lb. and burst strengths range from 50-750 psi for currently available geotextile fabrics. The required 7.2 psi fabric strength is greatly below the available fabric strength of 50 to 70 psi.

#### Reinforcement

Geotextiles, having tensile-strength properties, can be used to complement those materials weak in tension. Therefore, low-strength soils are prime targets for geotextile reinforcement. Geotextiles used with soils that have a California Bearing Ratio (CBR) of less than 3.0 will generally provide reinforcement in a typical situation while geotextiles used with soils with a CBR higher than 6.0 will have a negligible amount of reinforcement occurring.

The Daviess County Soil Survey indicates the Negley soil map unit in the targeted site 1 area and Hickory soil map unit in the site 2 area. In both cases, the topsoil has been lost to erosion and the subsoil horizons are typically classified as CL material according to the Unified Soil Classification System or A-6 according to AASHTO. A correlation chart for estimating soil strength values implies CL material has a CBR rating of at least 5. Therefore, the function of reinforcement is not required for the application under review.

#### Filtration

The geotextile function of filtration involves the movement of liquid through the fabric itself, that is, across its manufactured plane. Drainage, on the other hand, involves the movement as planar flow within the structure of the geotextile. Drainage occurs in the in-plane direction while filtration is cross-plane.

Filtration presents a two-fold demand for adequate permeability and soil retention.

## Permeability

The permeability of the geotextile must exceed the inherent permeability of the soil involved. The Daviess County Soil Survey presents general information regarding the permeability of the soils involved. The subsoil horizons involved reportedly have permeabilities ranging from 0.63 to 2.0 in./hr. Using a conservative value of 2, the permeability ( $K$ ) in more common units is approximately equivalent to  $5 \times 10^{-5}$  ft/sec.

Geotextile fabric permeability is a function of the fabric thickness which is included in the permeability coefficient. One must quantify the fabric's permeability (cross plane) by employing the formula for permittivity, which is defined:

$$\Psi = k_r/t$$

where

$\Psi$  = permittivity

$k_r$  = permeability coefficient or hydraulic coefficient normal to the fabric

$t$  = thickness of the fabric (mils)

The geotextile proposed is an 8 oz fabric which is 100 mil thickness.

$$\Psi_{\text{required}} = 5 \times 10^{-5} / 100 = 5 \times 10^{-7}$$

A review of product specification literature suggests permittivity values for nonwoven needle punched geotextiles range from approximately  $10^1$  to  $10^{-3}$  therefore a suitable, readily available geotextile is available that is more permeable (by several orders of magnitude) than the soil underlying the geotextile.

## Soil Retention

As one allows for greater flow of water through the geotextile, the void spaces in it must be made larger. A limit is reached however when soil particles start to pass through the fabric voids along with the flowing liquid. To retain the soil, voids must be small enough to initially retain the coarser soil fraction and this is the targeted soil size in the design process.

There are a number of approaches however the simplest method examines the percentage of soil passing the No. 200 sieve (= 0.074 mm). Two general categories are:

1. Soil having less than or equal to 50% passing through the No. 200 sieve, apparent opening size (AOS) of the fabric needs to be greater than or equal to a No. 30 sieve (0.59 mm)

WEST BOGGS LAKE  
SHORELINE STABILIZATION  
DESIGN ANALYSIS

RCS Technical Release 69 RIPRAP DESIGN FOR PROTECTING SLOPES AGAINST WAVE ACTION was utilized to evaluate the proposed non-standard design.

The principal factor affecting the design for slope protection is wave action and the assumption is made that wave height is a direct measure of the erosiveness of the wave attack. To evaluate wave height, the following factors that create waves in open water must be analyzed.

- . Design wind direction
- . Effective fetch
- . Wind velocity and duration

Factors determining the successful performance of the slope protection include the:

- Rock size
- Gradation of riprap
- Weight of the rock
- Thickness of riprap layer
- Roughness of riprap surface
- Slope(s) of the embankment face
- Condition of filter or bedding

#### DETERMINATION OF SIGNIFICANT WAVE HEIGHT

. Determine Design Wind Direction  
based on 1999 Annual Summary of Local Climatological Data for Evansville, IN using Normals, Means, and Extremes for a Period of Record 1997-1999. See Exhibit A

1	2	3	4	5
Month	Speed (mph)	Direction	Azimuth	Col 2 x Col 4
January	34	W	260	8840
February	41	W	270	11070
March	33	WNW	290	9570
April	44	W	280	12320
May	46	W	270	12420
June	34	N	360	12240
July	34	NW	330	11220
August	37	W	270	9990
September	31	W	270	8370
October	33	WSW	250	8250
November	38	SW	240	9120
<u>December</u>	<u>30</u>	<u>NNE</u>	<u>200</u>	<u>6000</u>
	435		3290	119410

WIND DIRECTION  $\frac{119410}{435} = 275$  West

CHECK FOR COMPARISON  $\frac{3290}{12} = 274$

westward wind does not impinge on Site 2 therefore go to alternate method.  
direction of longest stretch of open water from Site 2 = 120 degrees

2. Soil having greater than 50% passing through the No. 200 sieve, AOS of the fabric needs to be greater than or equal to a No. 50 sieve (0.297 mm)

The Soil Survey indicates a range of 40-75% of the soil passing the No. 200 sieve therefore a geotextile having an AOS sieve rating greater than 50 (less than or equal to 0.297 mm) is required.

### **Conclusion**

The geotextile used in this application must have a burst strength greater than 7.2 psi which is characteristic of all nonwoven, needle-punched geotextile fabric. The geotextile used should also have an apparent opening size (AOS) sieve rating greater than 50.

D. Determine Significant Wave Height

Significant wave height can be determined from a figure entitled Generalized Correlations of Significant Wave Heights with Related Factors found in Technical Release 69, by use of the computed design wind velocity and the effective fetch.

Inland reservoir studies resulted in dimensionless relationships that can be approximated by:

$$gH_s/U^2 = 0.0026(gF_e/U^2)^{0.47} \quad \text{and} \quad = 0.460 (gF_e/U^2)^{0.28}$$

where:

$F_e$  = effective fetch

$H_s$  = significant wave height

$T$  = wave period

$H_s = 1.1$  ft.



B. Determine Effective Fetch

1	2	3	4	5	6
Radian				$X_i$ Scale	
No.	$\alpha$	$\cos \alpha$	$\cos^2 \alpha$	Distance (ft)	Col 4 x Col 5
1	42	0.743	0.552	1500	828.1
2	36	0.809	0.654	1500	981.7
3	30	0.866	0.750	1900	1424.9
4	24	0.914	0.835	2300	1921.4
5	18	0.951	0.904	2500	2261.0
6	12	0.978	0.956	2500	2391.2
7	6	0.995	0.990	2500	2475.1
8	0	1	1.000	2500	2500.0
9	6	0.995	0.990	2300	2277.1
10	12	0.978	0.956	1900	1817.3
11	18	0.951	0.904	2200	1989.7
12	24	0.914	0.835	2200	1837.9
13	30	0.866	0.750	1900	1424.9
14	36	0.809	0.654	1200	785.4
15	42	<u>0.743</u>	<u>0.552</u>	<u>1200</u>	<u>662.5</u>
		13.512		30100	25570.9

Effective Fetch ( $F_e$ ) =  $\frac{25570.9}{13.512}$  ft. = 1892 ft. = 0.358 mile

Check:  $F_e = \frac{30100}{15 (5280)}$  = 0.380 mile

C. Determine Design Wind Velocity and Duration  
Based on climatological data

Month	Max mph (2 minute)			
January	34			
February	41	Overland wind velocity ( $U_L$ ) =	$\frac{435}{12}$	= 36.3 mph
March	33			
April	44			
May	46			
June	34	Average observed values for wind relationship overwater to overland were plotted to yield a wind ratio as a function of effective fetch.		
July	34			
August	37			
September	31			
October	33			
November	38	Overwater wind velocity ( $U_W$ )		
December	<u>30</u>	Wind Ratio from plotted graph ( $U_W/U_L$ ) =	1.08	for calculated $F_e$
	435			
		$U_W = (U_W/U_L)(U_L) =$	$(1.08)(36.3) = 39.2$ mph	

- i. Design of Riprap Protection for Slopes
- ii. Rock Size ( $W_{50}$ )

$$W_{50} = 19.5 G_s H_s^3 / (G_s - 1)^3 \cot \alpha$$

where:

$G_s$  = specific gravity of rock = 2.65

$\alpha$  = 6 = slope ratio of foreslope proposed

$$W_{50} = 2.55 \text{ (Say 3.0)}$$

- i. Gradation and Thickness

$$D_{50} = (1.24)(W/(62.4)(G_s))^{0.33} = 0.326 \text{ ft} \quad \text{Say 0.4 ft.}$$

Gradation based on well graded rock dumped in place.

Gradation

Factor	Percent Passing by Weight	Range (Min-Max)
1.5-2.0	100	0.6-0.8
1.3-1.8	85	0.52-0.72
1.0-1.4	50	0.4-0.56
0.72-1.1	15	0.29-0.44
0.65	0	0.26

$$\text{Minimum thickness} = 2(D_{50}) = 2 \times 0.4 = 0.8 \text{ ft} = 10 \text{ inches}$$

C. Slope Protection Layout

1. Lower Limit Elevation (Elev<sub>LL</sub>)

Normal pool elevation (Elev<sub>NP</sub>)                      499.6

$$\begin{aligned}\text{Elev}_{LL} &= \text{Elev}_{NP} - 1.5 (H_s) \\ &= 499.6 - (1.5)(1.1) \\ &= 497.95 \text{ or } 1.65' \text{ below pool}\end{aligned}$$

2. Upper Limit Elevation (Elev<sub>UL</sub>)

Wave runup (R)

Wave Length (L) relationship exists between Design Wind Velocity and Effective Fetch and has been graphed to determine L or use the following formula:

$$gL^{-2}/U_w = 1.041 (g F_e/U_w^2)^{0.28}$$

$$U_w = 39.2 \text{ mph}$$

$$F_e = 0.358 \text{ miles}$$

$$L = 18$$

Wave Runup Ratio relationship exists between the embankment slope, the relative runup ratio (R/H<sub>s</sub>), and height/length (H<sub>s</sub>/L) ratio. Relationship has been graphed for various H<sub>s</sub>/L ratios.

$$H_s/L = 1.1/18 = 0.06$$

R/H<sub>s</sub> from graph based on H<sub>s</sub>/L ratio of 0.06 and 2:1 backslope is 1.65

$$R = (R/H_s) H_s = 1.65 \times 1.1 = 1.8'$$

Wind Setup (S)

$$S = 0.1 H_s = 0.1 \times 1.1 = 0.11$$

$$\text{Elev}_{UL} = \text{Elev}_{NP} + R + S$$

$$= 499.6 + 1.8 + 0.11$$

$$= 501.51 \quad 1.91' \text{ above normal pool}$$

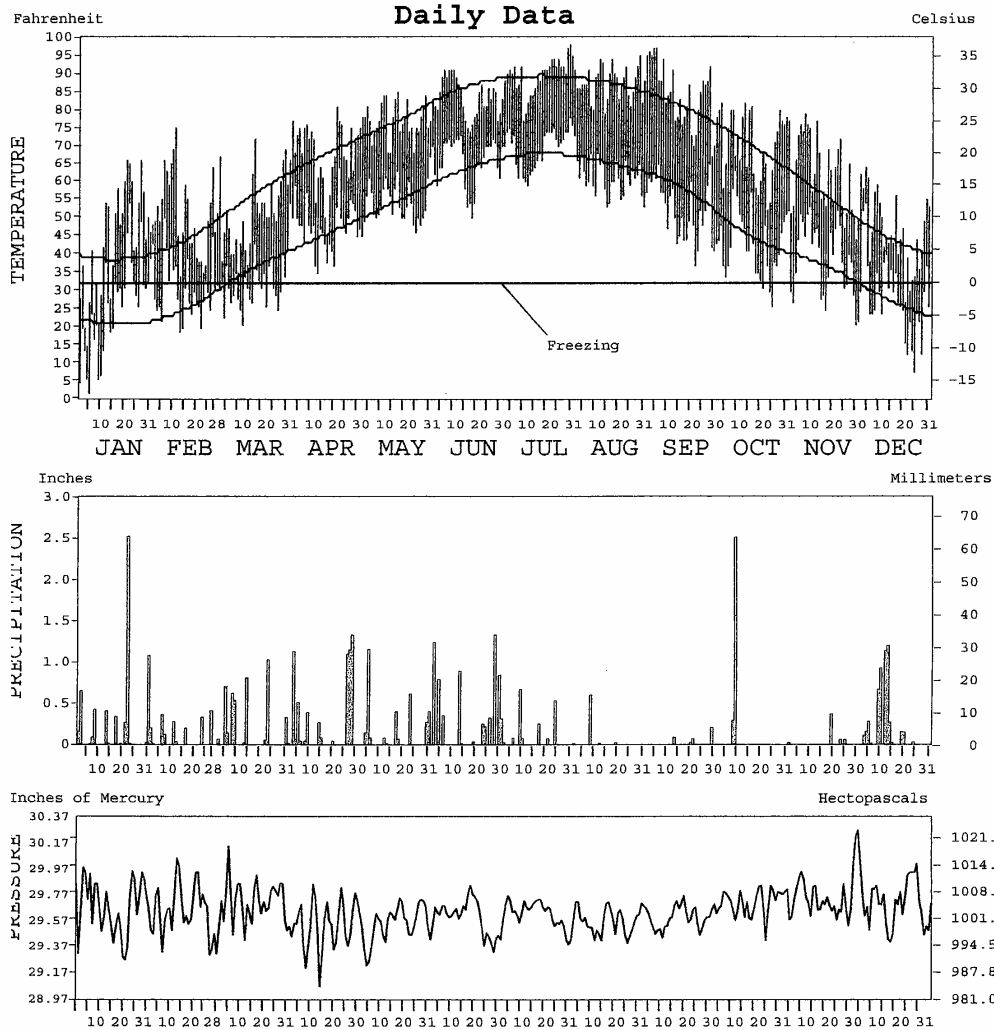
EXHIBIT A

# 1999 LOCAL CLIMATOLOGICAL DATA ANNUAL SUMMARY WITH COMPARATIVE DATA

EVANSVILLE,  
INDIANA (EVV)



ISSN 0198-1943



I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION      NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE      NATIONAL CLIMATIC DATA CENTER ASHEVILLE, NORTH CAROLINA      *Thomas R. Karl* DIRECTOR NATIONAL CLIMATIC DATA CENTER

# METEOROLOGICAL DATA FOR 1999

EVANSVILLE, IN (EVV)

LATITUDE: 38° 02' 35" N LONGITUDE: 87° 32' 13" W ELEVATION (FT): GRND: 381 BARO: 381 TIME ZONE: CENTRAL (UTC + 6) WBAN: 93817

	ELEMENT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE ° F	MEAN DAILY MAXIMUM	43.5	50.8	51.3	67.6	77.1	83.4	89.4	87.5	84.2	70.4	62.7	46.5	67.9
	HIGHEST DAILY MAXIMUM	66	75	72	81	85	91	98	95	97	82	79	64	98
	DATE OF OCCURRENCE	27+	11	17	21	17	10+	30	29	05+	13+	08	04	JUL 30
	MEAN DAILY MINIMUM	25.8	31.0	31.7	47.8	53.8	65.6	69.4	61.3	52.2	42.8	39.8	28.1	45.8
	LOWEST DAILY MINIMUM	2	19	21	35	45	50	59	53	37	26	21	8	2
	DATE OF OCCURRENCE	05	13	12	13	02	18	12	31+	22	25	30	25	JAN 05
	AVERAGE DRY BULB	34.7	40.9	41.5	57.7	65.5	74.5	79.4	74.4	68.2	56.6	51.3	37.3	56.8
	MEAN WET BULB		37.5	36.9	53.3	60.0		73.5	66.6	58.2	50.8	45.6	34.8	
	MEAN DEW POINT		31.4	29.6	48.7	55.2		70.7	61.7	50.1	44.5	38.8	29.4	
	NUMBER OF DAYS WITH:													
	MAXIMUM ≥ 90°	0	0	0	0	0	4	19	11	8	0	0	0	42
	MAXIMUM ≤ 32°	9	0	0	0	0	0	0	0	0	0	0	2	11
	MINIMUM ≤ 32°	22	18	18	0	0	0	0	0	3	9	22	92	92
	MINIMUM ≤ 0°	0	0	0	0	0	0	0	0	0	0	0	0	0
H/C	HEATING DEGREE DAYS	931	667	720	220	39	4	0	0	53	257	404	854	4149
	COOLING DEGREE DAYS	0	0	0	10	59	297	454	298	158	8	0	0	1284
RH	MEAN (PERCENT)	78	69	65	72	71	77	76	68	57	68	66	73	70
	HOURLY 00 LST	79	76	74	78	85	88	89	83	71	81	73	77	80
	HOURLY 06 LST	83	80	78	83	87	89	90	89	85	87	78	81	84
	HOURLY 12 LST	76	60	53	64	55	63	61	47	35	49	51	63	56
	HOURLY 18 LST	75	61	55	63	60	67	65	54	41	58	60	70	61
S	PERCENT POSSIBLE SUNSHINE													
W/O	NUMBER OF DAYS WITH:													
	HEAVY FOG (VISIBY ≤ 1/4 MI)	1	1	1	3	2	0	4	0	0	0	1	0	13
	THUNDERSTORMS	3	1	2	9	4	9	5	2	0	1	1	1	38
CLOUDINESS	SUNRISE-SUNSET: (OKTAS)													
	CEILOMETER (≤ 12,000 FT.)													
	SATELLITE (> 12,000 FT.)													
	MIDNIGHT-MIDNIGHT: (OKTAS)													
	CEILOMETER (≤ 12,000 FT.)													
	SATELLITE (> 12,000 FT.)													
	NUMBER OF DAYS WITH:													
	CLEAR													
	PARTLY CLOUDY													
	CLOUDY													
PR	MEAN STATION PRESS. (IN.)	29.68	29.66	29.71	29.53	29.56	29.60	29.62	29.57	29.60	29.72	29.76	29.71	29.64
	MEAN SEA-LEVEL PRESS. (IN.)	30.11	30.09	30.13	29.95	29.97		30.02	29.98	30.01	30.13	30.18	30.14	
WINDS	RESULTANT SPEED (MPH)		1.6	2.6	2.1	0.7	0.3	1.1	2.2	1.6	0.9	2.0	2.2	
	RES. DIR. (TENS OF DEGS.)		25	01	23	26	24	27	34	34	30	27	27	
	MEAN SPEED (MPH)	9.1	8.7	8.6	9.0	6.7	5.8	5.2	5.6	5.5	5.8	7.1	8.1	7.1
	PREVAIL. DIR. (TENS OF DEGS.)	21	18	32	26	20	05	25	05	34	34	23	20	21
	MAXIMUM 2-MINUTE WIND:													
	SPEED (MPH)	34	39	28	37	46	34	31	37	22	25	28	28	46
	DIR. (TENS OF DEGS.)	26	24	31	26	27	36	26	27	32	31	33	24	27
	DATE OF OCCURRENCE	22+	07	05	16	17+	04	01	07	08	22+	02	15	MAY 17+
	MAXIMUM 5-SECOND WIND:													
	SPEED (MPH)	41	51	36	46	68	40	37	44	29	31	37	36	68
	DIR. (TENS OF DEGS.)	25	24	31	26	23	35	33	27	22	33	31	28	23
	DATE OF OCCURRENCE	22+	07	05	16	05	04	09+	07	26+	22+	02	15	MAY 05
PRECIPITATION	WATER EQUIVALENT:													
	TOTAL (IN.)	6.00	1.94	4.30	6.15	3.21	6.27	2.00	0.64	0.39	2.80	0.51	5.13	39.34
	GREATEST 24-HOUR (IN.)	2.52	0.48	1.08	1.80	1.28	1.33	0.74	0.60	0.21	2.63	0.37	1.60	2.63
	DATE OF OCCURRENCE	22	06-07	22-23	27-28	04-05	28	09-10	08	29	08-09	19	09-10	OCT 08-09
	NUMBER OF DAYS WITH:													
	PRECIPITATION ≥ 0.01	14	9	10	13	10	11	8	4	4	2	4	13	102
SNOWFALL	PRECIPITATION ≥ 0.10	8	7	7	7	6	9	4	1	1	2	1	10	63
	PRECIPITATION ≥ 1.00	2	0	1	4	1	2	0	0	0	1	0	2	13
	SNOW, ICE PELLETS, HAIL:													
	TOTAL (IN.)	1.1	3.3	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7.5
	GREATEST 24-HOUR (IN.)	0.7	3.3	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.3
	DATE OF OCCURRENCE	07	23	14									24	FEB 23
	MAXIMUM SNOW DEPTH (IN.)	1	T	T	0	0	0	0	0	0	0	0	T	1
	DATE OF OCCURRENCE	09	24+	16+									25+	JAN 09
	NUMBER OF DAYS WITH:													
	SNOWFALL ≥ 1.0	0	1	1	0	0	0	0	0	0	0	0	0	2

# NORMALS, MEANS, AND EXTREMES

EVANSVILLE, IN (EVV)

LATITUDE: 36° 02' 35" N LONGITUDE: 87° 32' 13" W ELEVATION (FT): 381 TIME ZONE: CENTRAL (UTC + 6) WBAN: 93817

ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
NORMAL DAILY MAXIMUM	30	38.9	43.7	55.9	67.4	76.9	86.2	89.1	87.2	80.7	69.6	55.9	43.6	66.3
MEAN DAILY MAXIMUM	52	40.1	45.2	55.2	67.3	76.9	85.9	88.8	87.3	81.0	70.1	55.5	44.3	66.5
HIGHEST DAILY MAXIMUM	59	76	79	84	91	95	104	105	102	103	94	83	77	105
YEAR OF OCCURRENCE		1943	1962	1986	1989	1975	1954	1954	1983	1954	1953	1961	1982	JUL 1954
MEAN OF EXTREME MAXS.	52	63.3	67.7	77.3	84.1	89.3	95.6	96.9	95.7	93.1	85.6	74.8	65.3	82.4
NORMAL DAILY MINIMUM	30	21.2	25.0	35.7	45.0	54.2	63.3	67.5	64.9	57.6	44.7	36.5	26.7	45.2
MEAN DAILY MINIMUM	52	23.3	26.6	34.9	45.1	54.6	63.6	67.7	65.0	57.2	45.0	35.6	27.6	45.5
LOWEST DAILY MINIMUM	59	-21	-23	-9	23	28	41	47	43	31	21	-3	-15	-23
YEAR OF OCCURRENCE		1977	1951	1960	1990	1963	1966	1947	1986	1942	1952	1950	1989	FEB 1951
MEAN OF EXTREME MINS.	52	1.1	6.2	17.8	28.9	39.3	50.2	56.3	53.6	41.7	29.5	19.2	7.9	29.3
NORMAL DRY BULB	30	30.1	34.4	45.8	56.2	65.5	74.8	78.4	76.1	69.2	57.2	46.2	35.2	55.8
MEAN DRY BULB	52	31.8	35.9	45.0	56.1	65.7	74.7	78.3	76.3	69.1	57.5	45.5	35.9	56.0
MEAN WET BULB	15	30.3	34.2	41.0	50.4	59.9	67.9	71.4	64.8	62.2	51.5	39.9	31.1	50.4
MEAN DEW POINT	15	25.5	28.9	34.6	44.1	54.9	63.6	67.8	61.3	57.9	46.2	35.0	26.7	45.5
NORMAL NO. DAYS WITH:														
MAXIMUM ≥ 90°	30	0.0	0.0	0.0	0.1	2.0	9.5	15.3	10.8	4.4	0.3	0.0	0.0	42.4
MAXIMUM ≤ 32°	30	10.2	5.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	5.4	22.6
MINIMUM ≤ 32°	30	25.3	20.3	13.0	2.6	0.1	0.0	0.0	0.0	0.0	3.3	11.7	22.0	98.3
MINIMUM ≤ 0°	30	2.3	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	4.4
NORMAL HEATING DEG. DAYS	30	1082	857	595	273	114	0	0	0	33	266	564	924	4708
NORMAL COOLING DEG. DAYS	30	0	0	0	9	130	294	415	344	159	25	0	0	1376
NORMAL (PERCENT)														
HOUR 00 LST	30	72	71	68	65	68	68	71	73	73	69	71	74	70
HOUR 06 LST	30	75	76	74	74	79	80	83	85	85	80	76	77	79
HOUR 12 LST	30	78	78	79	78	81	81	85	87	88	83	80	80	82
HOUR 18 LST	30	66	65	60	54	54	54	57	58	57	53	62	68	59
PERCENT POSSIBLE SUNSHINE	56	42	48	55	60	64	71	73	73	69	65	48	42	59
MEAN NO. DAYS WITH:														
HEAVY FOG (VISBY ≤ 1/4 MI)	59	2.3	1.5	1.1	0.4	0.6	0.5	0.8	1.0	1.4	1.4	1.2	2.0	14.2
THUNDERSTORMS	59	1.0	1.2	3.5	5.0	6.5	7.6	7.5	5.1	3.1	2.0	1.5	0.6	44.6
MEAN:														
SUNRISE-SUNSET (OKTAS)	56	5.7	5.4	5.4	5.2	4.9	4.6	4.2	4.0	4.0	3.9	5.1	5.5	4.8
MIDNIGHT-MIDNIGHT (OKTAS)	32	5.4	4.9	5.0	4.7	4.3	4.0	3.8	3.6	3.8	3.8	4.9	5.2	4.4
MEAN NO. DAYS WITH:														
CLEAR	56	6.6	6.5	6.5	6.8	8.5	8.1	9.2	11.1	11.3	12.3	7.7	6.5	101.1
PARTLY CLOUDY	56	5.3	6.3	8.1	8.3	8.6	11.4	12.1	11.0	8.3	7.4	6.6	6.0	99.4
CLOUDY	56	19.1	15.4	16.4	14.9	13.9	10.5	9.1	8.4	9.9	10.8	15.2	18.0	161.6
MEAN STATION PRESSURE (IN)	27	29.70	29.69	29.60	29.60	29.59	29.60	29.60	29.60	29.60	29.70	29.71	29.71	29.64
MEAN SEA-LEVEL PRES. (IN)	16	30.15	30.13	30.06	29.96	29.97	30.01	30.00	30.03	30.05	30.10	30.11	30.18	30.06
MEAN SPEED (MPH)	47	9.4	9.3	10.0	9.7	8.0	7.1	6.2	5.6	6.3	6.8	8.6	8.9	8.0
PREVAIL. DIR. (TENS OF DEGS)	31	34	32	31	18	22	22	24	22	17	18	21	32	18
MAXIMUM 2-MINUTE:														
SPEED (MPH)	3	34	41	33	44	46	34	34	37	31	33	38	30	46
DIR. (TENS OF DEGS)	3	26	27	29	28	27	36	33	27	27	25	24	20	27
YEAR OF OCCURRENCE		1999	1997	1997	1997	1999	1999	1997	1999	1997	1997	1998	1998	MAY 1999
MAXIMUM 5-SECOND:														
SPEED (MPH)	3	41	51	45	54	68	43	45	44	38	45	48	36	68
DIR. (TENS OF DEGS)	3	25	24	28	26	23	26	34	27	27	26	25	28	23
YEAR OF OCCURRENCE		1999	1999	1997	1997	1999	1997	1997	1999	1997	1997	1998	1999	MAY 1999
NORMAL (IN)	30	2.66	3.12	4.71	4.02	4.75	3.49	4.04	3.11	2.97	2.87	3.73	3.67	43.14
MAXIMUM MONTHLY (IN)	59	13.50	7.25	12.84	11.83	13.51	9.30	9.69	8.43	9.89	8.33	8.49	8.23	13.51
YEAR OF OCCURRENCE		1950	1956	1964	1996	1995	1943	1958	1977	1945	1941	1957	1982	MAY 1995
MINIMUM MONTHLY (IN)	59	0.51	0.27	0.89	1.10	0.91	0.65	0.18	0.13	0.39	0.01	0.51	0.56	0.01
YEAR OF OCCURRENCE		1981	1947	1941	1959	1965	1991	1974	1943	1999	1964	1999	1976	OCT 1964
MAXIMUM IN 24 HOURS (IN)	59	3.73	3.20	5.63	7.26	6.05	3.67	4.09	3.70	3.45	3.00	3.48	2.35	7.26
YEAR OF OCCURRENCE		1982	1986	1964	1996	1961	1996	1978	1977	1945	1976	1988	1990	APR 1996
NORMAL NO. DAYS WITH:														
PRECIPITATION ≥ 0.01	30	9.9	9.5	11.9	11.5	10.8	9.3	8.9	7.4	7.6	7.6	9.6	10.9	114.9
PRECIPITATION ≥ 1.00	30	0.6	0.9	1.1	1.0	1.3	0.8	1.2	1.1	0.7	0.7	1.1	0.9	11.4
NORMAL (IN)	30	4.9	4.3	2.6	0.5	0.0	0.0	0.0	0.0	0.0	0.*	0.6	2.6	15.5
MAXIMUM MONTHLY (IN)	59	21.3	18.4	20.2	8.6	T	T	0.0	0.0	4.6	6.9	10.4	21.3	21.3
YEAR OF OCCURRENCE		1977	1993	1960	1971	1993	1994			1990	1993	1958	1973	JAN 1977
MAXIMUM IN 24 HOURS (IN)	59	8.7	10.9	10.6	8.6	T	T	0.0	0.0	T	4.1	6.9	7.0	10.9
YEAR OF OCCURRENCE		1978	1993	1960	1971	1993	1994			1990	1993	1958	1963	FEB 1993
MAXIMUM SNOW DEPTH (IN)	51	14	12	13	4	0	0	0	0	0	2	7	7	14
YEAR OF OCCURRENCE		1978	1998	1960	1971						1993	1958	1984	JAN 1978
NORMAL NO. DAYS WITH:														
SNOWFALL ≥ 1.0	30	1.7	1.3	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	4.8

## PRECIPITATION (inches) 1999 EVANSVILLE, IN (EVV)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1970	1.00	2.57	6.30	7.74	3.33	5.94	3.49	2.82	3.25	4.70	1.98	2.81	45.93
1971	2.88	4.90	1.65	2.81	3.96	6.89	3.38	2.17	4.47	2.42	1.57	3.15	40.25
1972	1.68	3.05	5.05	6.66	1.84	1.92	5.31	2.49	1.25	3.06	5.47	4.49	42.27
1973	2.45	1.65	6.97	5.47	5.57	5.24	3.41	2.83	0.73	1.99	6.02	3.85	46.18
1974	3.63	1.51	4.54	3.66	6.38	3.81	0.18	6.89	3.90	1.88	3.85	3.04	43.27
1975	4.05	4.06	7.18	6.62	3.63	3.07	3.13	5.47	2.60	2.73	4.21	4.26	51.01
1976	2.11	2.61	2.25	1.30	7.48	4.24	2.14	0.24	3.29	4.82	1.05	0.56	32.09
1977	1.91	1.29	6.17	3.34	2.68	6.57	4.83	8.43	4.58	2.81	4.30	3.17	50.08
1978	2.64	0.76	4.69	3.49	3.93	0.84	7.66	3.64	2.72	1.61	4.86	6.12	42.96
1979	3.60	4.80	6.30	6.07	3.72	2.78	7.22	2.36	2.83	2.68	6.82	3.03	52.21
1980	1.77	1.25	4.38	2.73	4.10	6.01	4.50	2.15	2.51	3.13	2.34	0.89	35.76
1981	0.51	2.89	1.70	2.50	12.89	1.78	5.08	6.04	2.00	2.36	3.40	2.20	43.35
1982	9.15	1.65	5.07	3.24	4.29	2.95	2.62	3.41	6.07	1.75	4.25	8.23	52.68
1983	1.79	0.74	4.33	10.26	8.87	4.59	1.51	0.94	0.73	5.62	5.55	3.55	48.48
1984	0.85	2.55	7.02	5.75	2.89	3.35	1.50	2.70	6.97	5.13	5.05	5.99	49.75
1985	1.76	4.24	6.10	3.80	2.97	4.68	1.18	3.76	3.59	4.46	7.61	1.74	45.89
1986	1.15	5.77	2.64	2.29	2.93	3.77	5.39	2.07	3.84	3.30	2.35	2.18	37.68
1987	0.77	3.51	2.11	2.31	3.90	5.97	3.19	0.47	1.98	1.23	3.36	5.71	34.51
1988	3.28	3.94	2.89	1.77	1.33	1.11	6.63	2.72	1.19	2.86	7.96	2.75	38.43
1989	3.35	7.00	6.40	4.19	3.72	4.00	7.83	3.46	2.21	2.16	1.64	1.38	47.34
1990	4.26	5.60	2.15	3.75	11.34	3.22	1.01	3.47	2.54	4.81	2.92	7.45	52.52
1991	3.02	2.99	4.27	2.56	3.11	0.65	2.58	0.46	2.60	3.05	3.67	3.72	32.68
1992	0.85	1.51	4.50	1.19	3.44	1.44	8.40	4.39	2.89	1.17	4.34	1.69	35.81
1993	3.57	2.61	3.23	4.38	4.20	4.65	2.37	2.17	5.59	3.76	6.62	2.68	45.83
1994	3.18	2.32	1.88	5.77	0.94	3.45	2.30	2.52	2.61	2.67	6.52	2.59	36.75
1995	2.82	2.98	2.53	5.59	13.51	4.56	2.88	3.60	0.47	2.01	2.32	3.19	46.46
1996	3.51	1.50	5.19	11.83	7.32	7.78	4.56	1.20	8.45	2.53	6.66	3.50	64.03
1997	4.20	3.35	6.90	4.16	7.57	6.12	1.71	4.02	1.31	1.73	4.17	2.34	47.58
1998	2.24	2.71	3.07	8.50	5.91	5.31	3.89	3.91	0.49	3.38	2.78	3.48	45.67
1999	6.00	1.94	4.30	6.15	3.21	6.27	2.00	0.64	0.39	2.80	0.51	5.13	39.34
POR= 122 YRS	3.51	3.13	4.27	4.07	4.28	3.89	3.48	3.08	3.00	2.70	3.51	3.40	42.32

WBAN : 93817

## AVERAGE TEMPERATURE (°F) 1999 EVANSVILLE, IN (EVV)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1970	24.0	32.6	41.6	58.7	68.4	72.0	75.3	75.4	73.5	57.1	44.6	37.5	55.1
1971	29.8	33.6	42.0	56.1	63.4	79.3	77.1	76.6	72.7	63.8	45.7	42.1	56.9
1972	32.5	34.1	44.2	56.4	66.0	71.4	75.6	73.8	70.5	53.4	41.5	34.4	54.5
1973	32.7	34.6	53.6	55.1	62.4	75.8	79.1	77.5	73.2	62.1	49.6	34.1	57.5
1974	37.4	40.0	50.1	57.0	67.0	70.9	79.4	74.2	63.2	56.2	47.4	36.9	56.6
1975	36.8	38.3	42.6	55.1	69.6	76.2	77.8	77.3	66.5	58.4	48.8	36.9	57.0
1976	29.3	43.1	51.6	57.2	61.6	73.3	77.0	73.6	67.1	52.4	38.7	31.8	54.7
1977	14.8	33.9	51.2	61.5	72.0	75.4	80.9	76.9	72.4	55.6	48.8	33.5	56.4
1978	20.3	21.0	39.8	57.5	64.4	76.8	79.1	76.6	72.0	54.5	49.0	36.8	54.0
1979	20.9	24.6	46.7	54.3	63.5	75.1	76.6	74.8	68.3	56.5	44.1	38.6	53.7
1980	33.1	26.8	40.3	52.8	65.4	73.2	82.0	81.6	72.4	55.4	45.1	37.3	55.5
1981	29.6	37.2	44.7	61.7	61.4	76.6	78.5	75.9	67.2	57.0	48.3	34.5	56.1
1982	27.4	32.1	47.8	52.1	70.7	70.7	79.6	74.1	67.5	59.2	48.9	45.2	56.3
1983	35.2	39.3	46.5	51.5	62.7	74.7	81.4	81.9	70.6	59.3	47.7	26.2	56.4
1984	27.1	39.0	40.0	54.4	62.5	78.6	76.0	76.0	66.3	62.9	43.5	43.7	55.8
1985	23.7	29.6	51.9	59.1	66.5	73.7	79.2	75.1	68.5	60.7	50.1	28.2	55.5
1986	32.9	37.5	47.5	58.1	67.6	76.7	80.5	72.9	72.4	58.0	43.7	35.7	57.0
1987	32.2	38.5	47.9	54.2	71.7	76.5	78.3	77.9	71.0	51.2	49.5	39.7	57.4
1988	29.0	33.1	45.4	55.6	67.0	75.7	79.0	78.8	69.5	51.5	46.4	36.5	55.6
1989	40.1	32.5	46.9	56.6	63.2	73.8	77.7	76.8	68.3	58.3	45.6	23.0	55.2
1990	41.9	43.2	49.8	53.8	63.0	74.9	77.2	75.7	71.0	56.1	50.5	38.1	57.9
1991	31.3	39.7	47.9	58.9	71.1	77.0	79.1	77.0	70.2	59.2	43.2	39.2	57.8
1992	35.4	41.6	47.0	57.7	63.9	71.7	79.0	73.4	68.6	57.7	46.9	36.4	56.6
1993	36.5	32.9	43.1	54.1	67.0	75.8	83.1	79.5	67.0	55.5	44.7	36.4	56.3
1994	27.3	37.3	45.4	59.2	64.0	78.8	79.2	75.4	68.1	59.7	51.4	42.2	57.3
1995	35.0	36.1	49.9	58.3	66.4	76.0	81.1	83.4	68.7	60.3	41.2	35.6	57.7
1996	30.9	36.2	38.3	51.5	67.3	74.0	75.2	75.7	66.0	56.8	40.4	38.0	54.2
1997	29.0	39.7	47.3	50.5	60.3	72.0	77.2	74.1	67.8	57.3	41.8	35.0	54.3
1998	39.5	42.1	46.2	54.8	69.8	75.1	77.7	76.7	73.9	60.0	48.3	38.8	58.6
1999	34.7	40.9	41.5	57.7	65.5	74.5	79.4	74.4	68.2	56.6	51.3	37.3	56.8
POR= 103 YRS	33.1	35.9	45.7	56.1	65.9	75.1	78.8	77.0	70.3	58.7	46.2	36.1	56.6

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WBAN : 93817

HEATING DEGREE DAYS (base 65°F) 1999 EVANSVILLE, IN (EVV)

BAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
70-71	2	0	24	255	605	846	1087	874	707	290	90	0	4780
71-72	0	0	23	85	571	701	1000	887	639	274	64	16	4260
72-73	2	3	26	356	702	940	997	844	345	312	106	0	4633
73-74	0	0	11	160	459	954	849	696	480	264	71	6	3950
74-75	0	0	124	280	537	865	867	742	689	319	23	0	4446
75-76	0	0	75	223	484	861	1100	628	417	275	139	0	4202
76-77	0	0	27	391	786	1021	1549	867	428	162	32	4	5267
77-78	0	0	3	289	495	970	1377	1228	774	233	137	0	5506
78-79	0	0	10	323	473	865	1360	1125	559	326	106	0	5147
79-80	0	1	28	290	619	813	982	1103	756	367	81	10	5050
80-81	0	0	24	329	591	852	1090	771	624	161	155	0	4597
81-82	0	0	53	256	498	940	1160	914	534	386	16	0	4757
82-83	0	0	52	233	486	618	918	711	567	406	106	4	4101
83-84	0	0	61	186	514	1195	1169	747	769	329	131	0	5101
84-85	0	0	79	108	638	653	1276	985	411	208	55	9	4422
85-86	0	0	75	185	446	1135	989	762	538	226	70	0	4426
86-87	0	15	14	240	632	900	1007	735	528	330	19	0	4420
87-88	0	0	15	423	456	777	1108	917	602	284	46	4	4632
88-89	0	0	18	418	548	877	765	902	558	308	142	1	4537
89-90	0	1	54	225	577	1297	707	603	487	358	97	15	4421
90-91	2	1	35	291	432	828	1037	702	528	191	42	0	4089
91-92	0	0	88	227	647	791	913	673	549	259	118	10	4275
92-93	0	0	46	236	538	875	879	892	671	322	46	12	4517
93-94	0	0	55	296	600	879	1164	770	603	213	96	5	4681
94-95	0	0	44	180	403	702	922	804	465	229	62	0	3811
95-96	0	0	50	168	710	904	1048	829	819	407	75	5	5015
96-97	0	0	70	253	732	830	1108	702	542	428	172	11	4848
97-98	0	0	24	300	692	922	786	635	604	301	30	20	4314
98-99	0	0	4	181	492	810	931	667	720	220	39	4	4068
99-	0	0	53	257	404	854							

WBAN : 93817

COOLING DEGREE DAYS (base 65°F) 1999 EVANSVILLE, IN (EVV)

BAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
770	0	0	0	43	169	220	329	331	286	18	0	0	1396
771	0	0	0	28	49	437	382	367	260	53	0	0	1576
772	0	0	2	21	99	214	337	285	196	2	4	0	1160
773	0	0	0	23	35	331	438	396	265	76	3	0	1567
774	0	0	26	28	141	188	452	292	73	14	15	0	1229
775	0	0	0	29	176	342	406	388	129	29	1	0	1500
776	0	0	6	47	40	258	379	274	98	10	0	0	1112
777	0	0	9	61	255	323	501	376	232	6	16	0	1779
778	0	0	0	16	125	361	444	366	229	7	2	0	1550
779	0	0	0	13	65	310	365	312	138	35	0	0	1238
780	0	0	0	5	102	264	535	521	257	39	3	0	1726
781	0	0	1	69	50	355	425	343	128	15	3	0	1389
782	0	0	10	3	198	179	458	290	134	59	9	11	1351
783	0	0	3	8	42	303	514	532	236	17	0	0	1655
784	0	0	0	16	60	416	348	349	127	49	0	0	1365
785	0	3	13	36	108	276	447	319	190	58	5	0	1455
786	0	0	2	27	156	360	487	265	246	32	0	0	1575
787	0	0	0	8	235	350	420	408	201	0	1	0	1623
788	0	0	0	11	113	329	441	436	162	8	0	0	1500
789	0	0	3	64	96	272	403	369	161	28	0	0	1396
790	0	0	21	29	43	318	387	336	220	23	3	0	1380
791	0	0	4	15	241	369	445	379	249	55	0	0	1757
792	0	0	0	47	90	219	440	268	162	14	0	0	1240
793	0	0	0	3	115	342	566	456	122	9	0	0	1613
794	0	1	0	42	74	423	449	330	144	24	2	0	1489
795	0	0	3	33	116	336	510	577	169	29	0	0	1773
796	0	0	0	8	154	282	321	338	105	6	0	0	1214
797	0	0	0	0	32	227	386	288	116	70	0	0	1119
798	0	0	28	3	188	330	398	370	276	35	0	1	1629
799	0	0	0	10	59	297	454	298	158	8	0	0	1284



1999  
EVANSVILLE,  
INDIANA (EVV)

Evansville, Indiana, is located on the Ohio River. The country around Evansville ranges from level to areas of rolling terrain near the river. Dress Regional Airport, where the observations have been taken since August 31, 1940, is located in a shallow valley with low hills to the east and west which parallel the valley, but slope down to the south. There are hills 5 miles to the north which are about 100 feet higher than the field. The open end of the valley slopes down and south toward the city of Evansville and the Ohio River.

Records of precipitation, temperature, and wind are available from the city office locations prior to August 1940. Both precipitation and temperature records were from roof-top exposures in the city and from ground exposures at the airport. The airport exposure is not subject to the effect of an early morning smoke blanket that was prevalent over the city during the downtown exposure.

Prevailing wind direction is from the south-southwest. The strongest winds occur during a deep winter storm passage through the Lower Ohio Valley. Strong and cold north to northwest winds occur from late autumn to early spring, most often, in January and February, as large domes of arctic high pressure moves into the midwest.

Geographically, Evansville lies in the path of moisture-bearing low pressure formations that move from the western Gulf region, northeastward over the Mississippi and Ohio Valleys to the Great Lakes and northern Atlantic Coast. Much of the precipitation results from these storm systems, especially in the cooler part of the year.

Both temperature and precipitation are closely related to the movement of the polar front and the storms which move along the front. This is especially true in the winter and spring months.

In summer and early autumn changes are less severe and periods of polar air invasions are less prolonged. There is considerable variation in seasonal and monthly temperature and precipitation from year to year as these factors depend greatly on the frequency of storm and frontal passages. A comparatively few miles difference in the distance of the paths of these storms, often spells the difference between whether the precipitation is snow, rain, or freezing rain during winter months.

Convective thunderstorms, developing in the maritime tropical air from the Gulf of Mexico and squall line activity, seem to be the factors which combine to supply the summer rainfall. The greatest precipitation intensities for short periods of time come in the months of greatest thunderstorm frequency. The greatest intensities for 24 hours or more are confined to the winter months when storm centers to the south produce a sustained flow of overrunning Gulf air.

Severe storms are rather infrequent but thunderstorms cause some wind damage each year. Hail often occurs with the stronger thunderstorms. Evansville is in tornado alley with the most frequent occurrence in early spring and late fall. The tornado frequency would probably be less than one every ten years for Evansville.

Snowfall varies greatly from season to season, as do rainfall and temperature. Of note is the fact that snowfalls of 2 or more inches are very infrequent, and these amounts are usually melted within a day or two.

The growing season averages 199 days, but has been as long as 250 days and as short as 169 days.

## STATION LOCATION

EVANSVILLE, INDIANA

EVANSVILLE, INDIANA																		
STATION	OCCUPIED FROM	OCCUPIED TO	AIRLINE DISTANCES AND DIRECTIONS FROM PREVIOUS LOCATION	NORTH	WEST	ELEVATION ABOVE											* TYPE	REMARKS
						SEA LEVEL	GROUND											
							GROUND	1200	1200	1200	1200	1200	1200	1200	1200	1200		
Building on Streets	1/1/77	1/31/95	NA	Unk	Unk													Precipitation observations only to July 1894.
	2/1/95	11/30/97	Unk	38°00'	87°38'	383												Complete climatological observations.
	12/1/97	12/31/15	Unk	37°58'	87°33'	387	82	72	72									
	National Bank, 4th & Main	1/1/16	6/30/26	800 ft. NE	37°58'	87°33'	388	175	139	139								
Building on Streets	7/1/26	8/30/40	800 ft. SW	37°58'	87°33'	387	116	76	76									
cal Building 1 Airport	10/19/29	7/13/34	NA	38°02'	87°32'	385	38		5									
cal Building 1 Airport +	8/31/40	2/21/51	No Change	38°02'	87°32'	385	40	12	11	Unk								a - Installed 11/19/40.
Memorial AP (live 10/29/50)																		b - Lowered 4/19/46.
Building Memorial Airport +	2/22/51	02/01/96	0.1 mi. N	38°03'	87°32'	383	64	7	7	52								
Regional AP (live 5/25/70)						e381	d20	g5	h5	h4	4	NA	NA	NA	NA	NA	NA	c - Telepsychrometer (7')
																		4/1/55-9/23/61. Hygro.
																		comm. 2100' NE of thermo-
																		meter site 9/23/61.
																		d - Effective 9/23/61.
																		e - Established 10/23/61.
																		f - Effective 3/13/64.
																		g - Effective 7/29/71.
																		h - Moved 100' NE 9/25/73.
																		i - Minor adjustment 11/16/77.
																		j - Type change 10/15/82.
																		k - Type change 10/23/85.
																		m - Minor move 3/3/92.
ional Airport	02/01/96	Present	NA	38°03'	87°32'	381												S ASOS Commissioned 02/01/96

Ordering information available through: National Climatic Data Center, Federal Building, Asheville, North Carolina 28801.  
INQUIRIES/COMMENTS CALL: (828) 271-4800

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MS-02

Site 2

WEST BOGGS LAKE

WEST BOGGS PARK

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St. Marys C.

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EXHIBIT C

West Boggs Park  
2000 LAKE Project  
TYPICAL SECTION Site 1

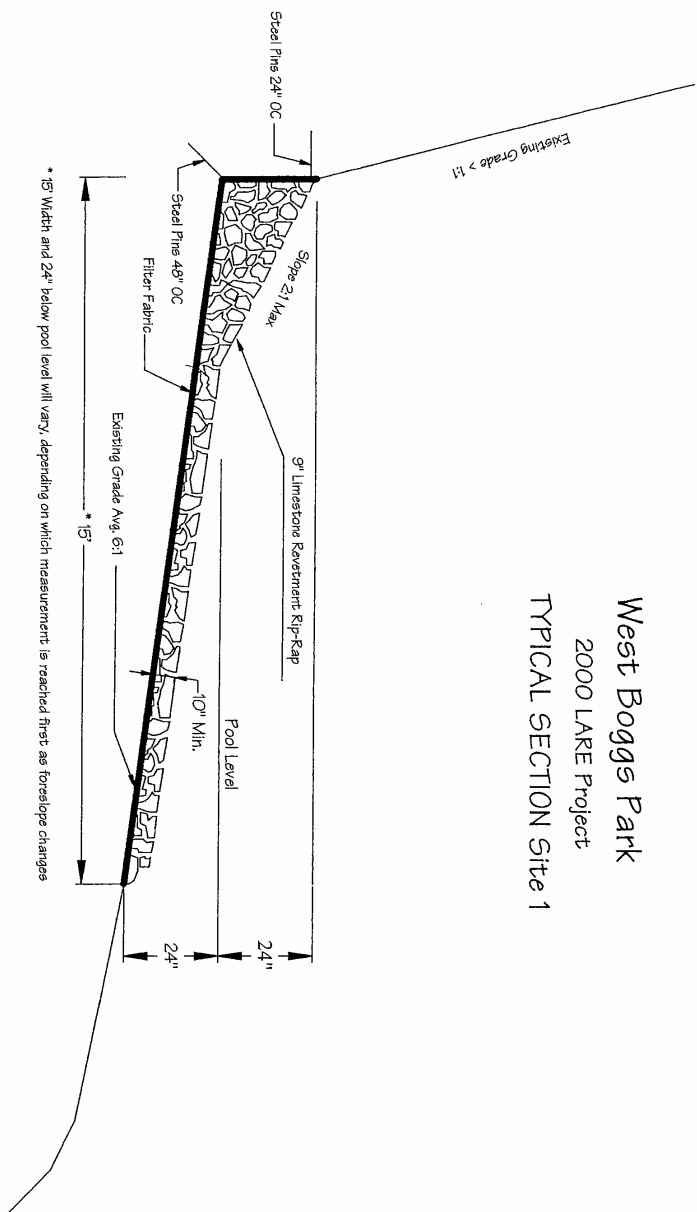
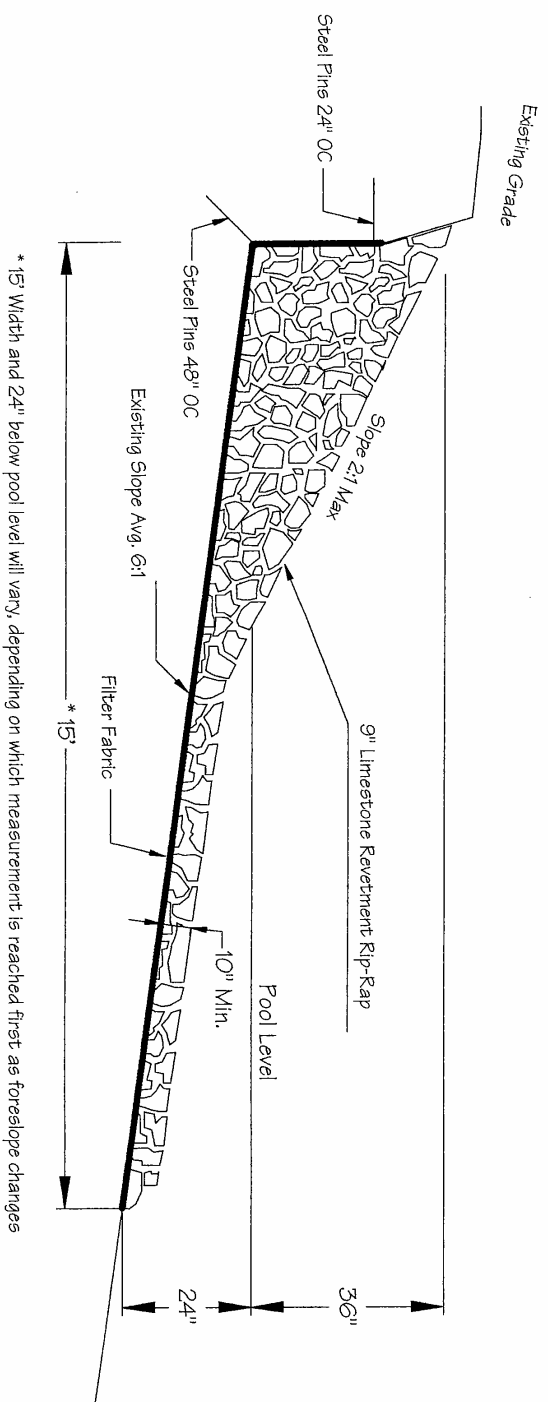


EXHIBIT D

West Boggs Park  
2000 LAKE Project  
TYPICAL SECTION Site 2



**SHORELINE STABILIZATION  
PROJECT**

Davess-Martin County Parks & Rec. Dept.  
P.O. Box 245  
Loogootee, IN 47553  
(812) 295-3421

Drawing By:  
Michael L. Aysom  
Superintendent

